Editorial

EVERY Easter, Federal Councillors of the Wireless Institute of Australia meet at a Convention in Melbourne to discuss and formulate Institute policy for the next twelve months. The WIA is the organised body of Australian amateur transmitters, of whom there are something more than 3000 in the country.

One of the most important resolutions passed at the Convention was to set up an emergency organisation for civil defence in time of war, using frequencies which might be left open to such amateur services should hostilities begin.

Before the last war, most frequencies used and developed by amateurs were such that communications on them could be heard overseas.

The position today is very different. Communicaton on such bands as 50 and 144 megacycles occupy hundreds of Australian amateurs from time to time. Stations spotted all over the country have put up some remarkable records for distances in excess of 200 miles almost night after night.

The important thing about this modern VHF activity, often carried on with elaborate and efficient equipment, is that the messages passed cannot be heard overseas. Despite their best efforts, amateurs have been heard outside Australia—apart from New Zealand—only on an odd occasion for a few minutes under exceptional conditions. It can be reasonably accepted that for practical purposes, frequencies of this order are secure for all but very important work.

Now, if Australia should be attacked, and communications disrupted, it is vitally important that we should have as many channels available as we can. A properly organised net of amateurs could weave a web around Australia which could, in all probability, never be put out of action. There is no valid reason to deny these frequencies in wartime to amateurs willing and able to form an emergency net. There will be plenty of competent men, and plenty of good equipment. All that is needed at this stage is vision on behalf of the authorities, and the green light to the amateurs.

In America similar plans are already under way. Like us, American amateurs realize that there will be no time to argue after hostilities have commenced.

Remember the job done by NSW amateurs in the North Coast floods? The tributes by Police and Federal Ministers? Amateurs can do an even better job in a greater emergency.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

EDITOR
JOHN MOYLE
S.M.I.R.E. (AUST.)

TECHNICAL EDITOR
NEVILLE WILLIAMS
M.I.R.E. (AUST.)

TECHNICAL STAFF
RAYMOND HOWE
MAURICE FINDLAY
PHILIP WATSON

Vol. 13 No. 2

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OUR COVER PICTURE

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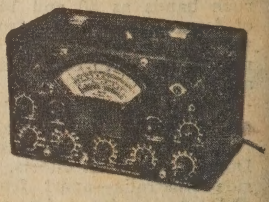

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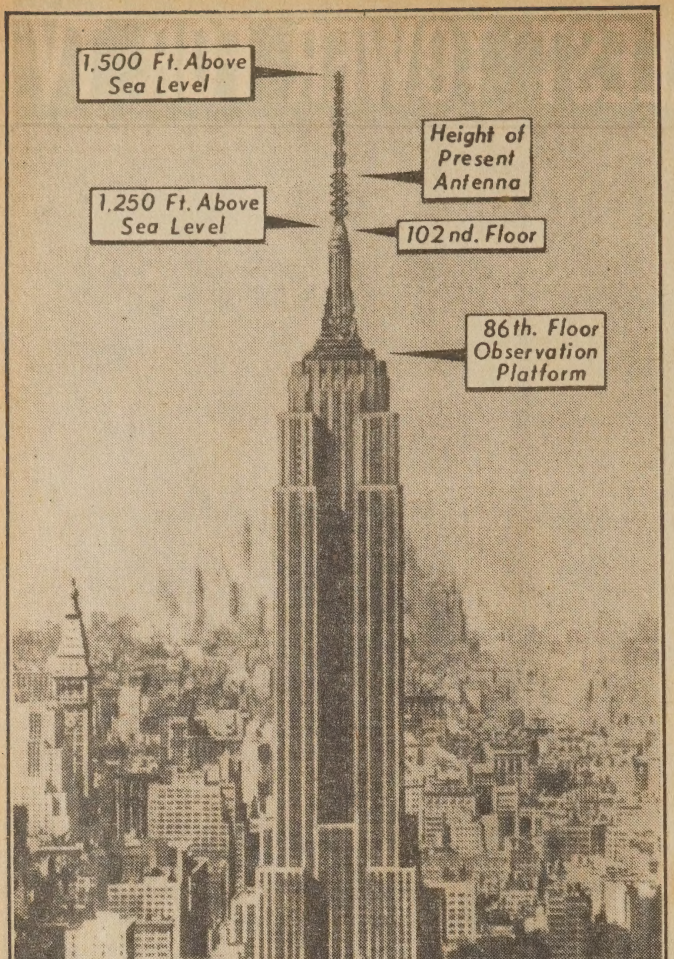
MAN'S TALLEST TOWER FOR TV

CLIMBING literally through the clouds drifting across New York, the tallest building in the world now carries the world's highest aerial system. On the Empire State building a 220ft tower supports the antennae of five TV and three FM stations. This tower tops every other structure yet erected on the face of the globe. (Story on page 4).



Television's tallest tower shown
New York's Empire State buildi
soaring to approximately 1500ft abo
street level.

HIGH SPOT IN TELEVISIO

Highest television and broadcasting aerials in the world are those erected on the Empire State Building, New York. The top of the aerial mast reaches 1500ft above the street level and from it five separate television and several FM broadcasting stations will radiate their programs.

THE rapid growth of television in and around New York set many engineering problems. The densely-packed metropolis—one of the world's largest—is possibly the best television district in the USA. Five services have been working to improve their programs and coverage for some years, casting envious eyes toward the enormous skyscraper—the highest man-made structure in the world.

Height is all-important for a television aerial or, for that matter, any aerial radiating a signal on the very short waves. Such waves travel comparatively short distances, their service area being more dependent on height than on any other single factor . The top of the Empire State Building represented the finest aerial position one could desire.

One reason why the Empire State location is so valuable is that, because of the large number of structures in the city, "shadow" "ghost" areas were experienced lower aerials, particularly on vision. These seriously upset gram reception in certain areas

In many ways, the very s waves behave like light waves. steel-framed structures, if they higher than the aerials, absorb reflect radiations from transmit

Thus each New York transm found that in the area immedia behind the buildings, reception reduced in strength, or comple cut off, almost as effectively a the aerial were radiating light stead of radio waves.

In addition to the shadow, t buildings reflect signals which thus rebroadcast from them, in fering with the direct signal b received and spoiling the pictur

FINE ENGINEERING

Thus it was decided to crea complete transmitting centre in Empire State to accommodate television and a number of other broadcast and VHF transmitters

The complete structure is a example of engineering. Becaus its great height, design had to vide for a wind pressure of 110 as wind velocities of 90 mph already been recorded . The job placed in the hands of a small gineering committee, and its mated cost on completion, with fixtures, transmission lines, &c nearly one million dollars.

The Empire State Building pay one-quarter million dollars the mast, building reinforceme &c., and share development with the users of the equipment

The aerial systems are of diffe types, but all are designed to vide a power gain of about times over a single dipole. mechanical and electrical consid tions made higher gain aerials desirable, not forgetting the e height required by more elabo arrays.

The topmost aerial, therefore of the "super" turnstile type, and four lower arrays a new "lad type. Each of the bays consist four broadband horizontal dip backed with infinite screen reflec spaced .3 wavelength away and ranged round the tower.

Electrical heating elements are vided in all elements for deici

It is anticipated that these ae might be used eventually to rac

re than one program each. At sent, however, the CBS transmit- is located on the 83rd floor with 275ft transmission line, the Du- nt on the 82nd with a 338ft line, erican Broadcasting on 85th with ft line, PIX on the 81st with a ft line, and National on the 85th h a 385ft line. All transmitters rated at 5 kw, but permissible put figures have not been specified.

One important matter not com- tely determined as yet is the pos- ility of interaction between the ials when all are operated to- her . There has so far been little portunity to observe what is likely happen in a parallel case, although has been found possible to operate ny powerful radar transmitters warships, for instance, with little ious interference.

CCESS WATCHED

The success or otherwise of the w York venture will no doubt be tched carefully by engineers all er the world, for similar problems ll almost certainly arise elsewhere. height is such an important factor VHF range and coverage, it is ely that there will be one spot in near a thickly-populated area hich is particularly suited for the ection of aerials, and which will sought after by a number of dif- ent interests.

Really high masts are very costly ms, and because VHF aerials are all, it becomes quite practicable group a number of them all at a od height above ground.

The principle of radiating more an one program from the same rial accentuates the advantages of ouping. Even on the broadcast nd, we have examples of this tech- ique, as represented, for instance, the use of the same aerial for C and 2BL.

So many stations will be interested the Empire State as an aerial wer that it seems certain to be a rtual nest of "skywires" before ry long. It is known that quite a mber of services are waiting on e results of the first tests to stake eir claims for some space. These its are bound to be successful, for station except those already using nporary aerials on the tower have en able to command anything like e extreme height and clear all- und coverage of the new aerials.

THER SERVICES

Services likely to be interested are t confined to television and broad- sting as such. Even the broad- sters themselves will rely sooner or er on micro-wave links for radia- g and accepting relayed programs m other sources. Such links, be- use of the more severe "optical" fect which goes with still higher equencies, will find the extreme ight even more valuable in ob- ining loud, clear signals over the aximum distance. To remote points located high above surrounding ter- rain, this range might well run to the best part of 100 miles.

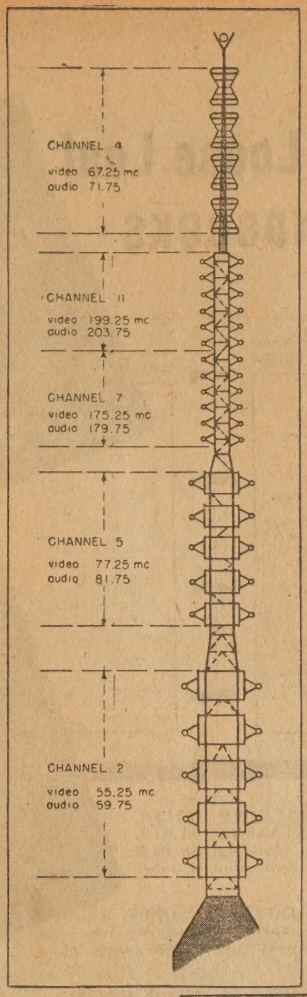
The aerials used for these links need not necessarily be mounted on the mast. They could even be mounted at the top of the building itself, as they are generally parabolic types similar in shape to large cir- cular home radiator reflectors. They are aimed directly at the remote stations with which they contact, so that building reflections and shield- ing in other directions won't be a problem.

MULTIPLE TRANSMISSIONS

Their accommodation might well cause some headaches to the Empire State, and places particular stress on the use of wideband aerials for mul- tiple transmissions. It is already proposed to use three FM stations on a single radiator, and even this num- ber might be exceeded. Because of the extremely wide band required for even a single TV station, this technique isn't so easy to apply for picture transmissions.

Incidentally each television sta- tion will pay 70,000 dollars annually for the use of the tower, plus 7 dol- lars per square foot for transmitter floor space. Total cost to each sta- tion will be about 100,000 dollars a year.

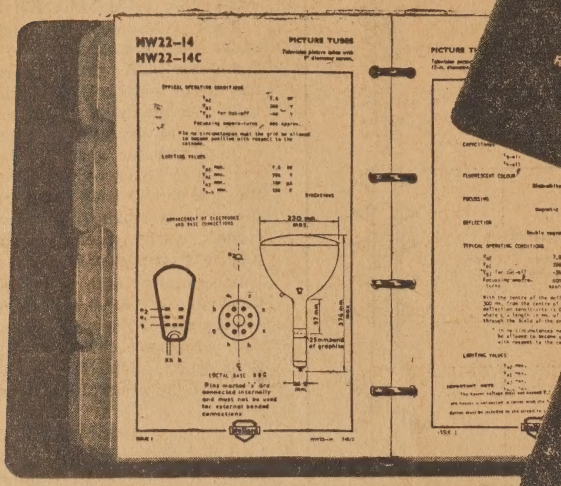
Other occupants of the tower will be weather observers with their array of instruments, together with several beacons to identify the tower to aircraft in all weathers.

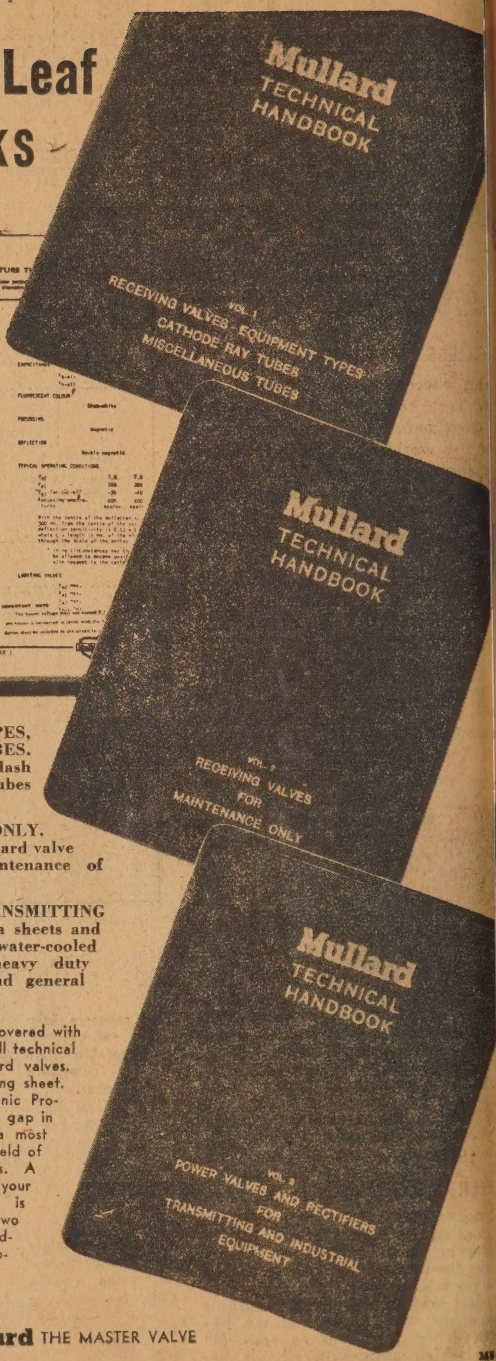


Five seperate television services will be operated from this composite aerial tower.

Riggers complete the tower—highest of man made structures.

Mullard Loose Leaf
VALVE DATA HANDBOOKS





Vol. 1: RECEIVING VALVES — EQUIPMENT TYPES, CATHODE RAY TUBES, MISCELLANEOUS TUBES. Includes television picture tubes, photographic flash tubes, voltage stabilising tubes, accelerometer tubes and general valve data.

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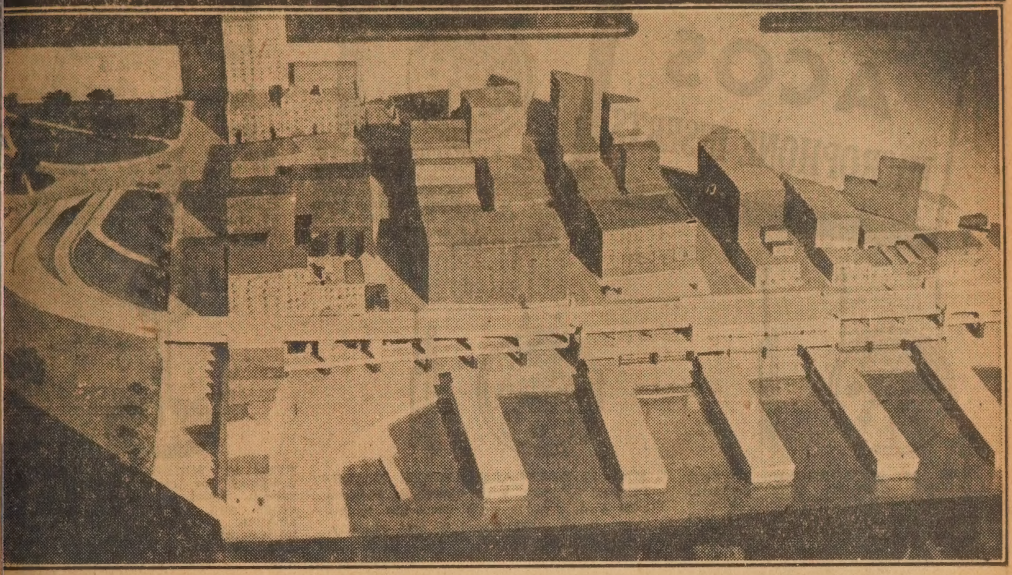
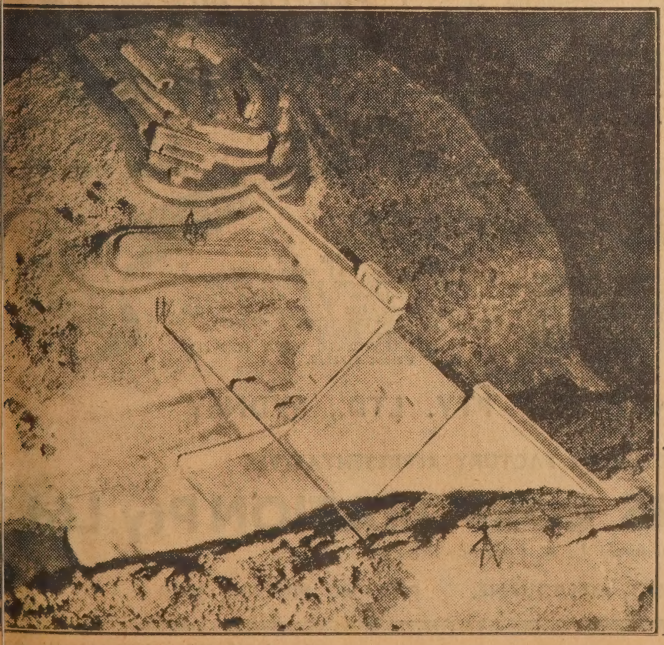
ENGINEERING WORLD IN MINIATURE



Usher brothers modelled four versions of Sydney's new Circular Quay Railway Scheme. Shown is design finally accepted by State Cabinet, will cost approximately £900,000 to complete.

In a small, efficient North Sydney factory, three young ex-servicemen have been showing engineers how their vast projects will appear when work is completed.



FOR three years now, brothers Bruce and Ross Usher have been applying their many and varied talents to earning a living and building a fascinating career out of model-making.

Two years ago, business was so brisk they brought in a third partner, Stan Walshaw, an ex-Army cobber of Ross', who had been working since war's end in various parts of New Guinea and the Islands for the Department of Public Health.

With projects such as the Warragamba Dam, Sydney's new Circular Quay Railway and the Zinc Corporation's Broken Hill installation behind them, the Usher brothers will undertake to make a miniature of just about anything you could name.

Right now, they are busy on a complete series of aircraft models for an Australian airline, a large number of terrain models for instruction of pupils at the School of Land-Air warfare (one of which, when finished, will measure 40 feet square) and the to-be-expected jobs for tourist bureaus, government de-

Warragamba Dam, when complete, will impound three times the water in Sydney Harbour, will have cost over £14 million. Brothers had to make a rough survey of the dam area themselves with ex-Army prismatic compass and improvised theodolite, for, at early stage when model was begun, proper survey had not been made.

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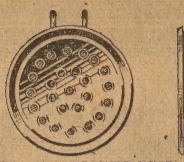

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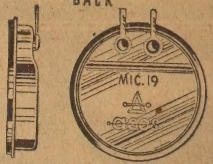

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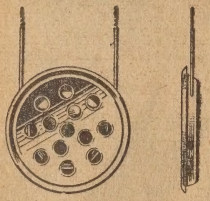

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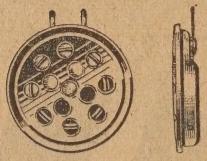

MIC. 14 STANDARD SPEECH MICROPHONE INSERT with nickel-plate brass case which gives high corrosion resistance, mechanical strength and rigidity.
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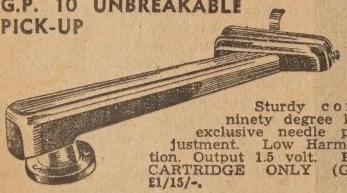

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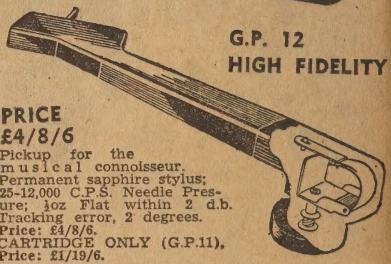

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artments and the larger industrial ompanies.

Following their Army discharge, ie Usher brothers, rather than work or a boss, decided to have a crack t building a business of their own. ready-made asset, a fully equipped ental workshop left by their father ho had been a dentist with a penhant for working at home, seemed o indicate a line of attack.

Coupled with some prewar comercial art experience, followed by amouflage wartime work and conur map and model-making on ruce's part and Ross' experience as adio technician and Army Medial Corpsman, the launching of a odel building business was virtuIly a foregone conclusion.

Their first important job, a prosed luxury tourist hotel for the ying-boat base at Rose Bay, was uccess enough to bring in orders hich have kept them happily busy ver since.

The amazing diversity of tools sed, from the most delicate dental aws, burrs and scalpels, right up o full-sized drilling machines, bandaws and a lathe, is matched only y the extraordinary variety of matrials pressed into service.

OVEL TOOLS

These range from the obvious wood nd scrap metal through to such hings as steel, wool, sponge rubber, lywire, perspex, leather and a myriad of odds and ends. Gallons f glue and paint, and pounds of crews and tacks and nails are conumed. Nothing is too bizarre or oo ordinary to use as long as it conributes its share to the final effect —*realism*.

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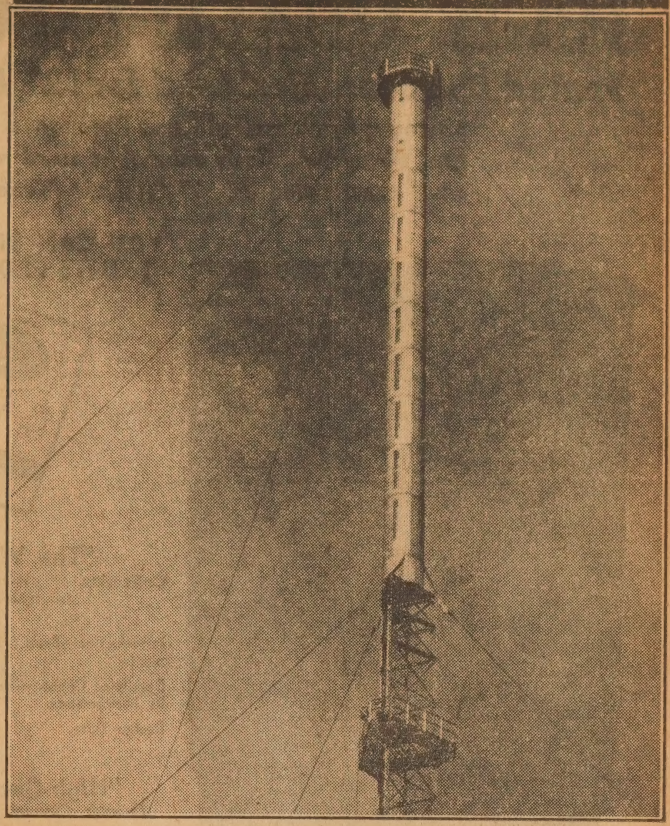
Experiments in new techniques nd applications of old materials are oing forward in a number of direcions, one of the most intriguing beng that of moulding terrain conours out of perspex to show the tructure of underground works of ube railways or water pumping tations.

"In this game, you have to be able o turn your hand to just about anyhing," says Bruce Usher. "But it's ighty interesting work and a elluva lot of fun!"

There speaks a happy man . . .

A NEW method of testing wear of internal combustion engine is to ake various parts radioactive by eans of the atomic pile. After a st run the oil is checked for the resence of radioactive metal parcles, which can be taken as an ndication of the engine wear.

B.B.C. TESTS FM AGAINST AM



The distinctive aerial of the British Broadcasting Corporation's Very High Frequency transmitting station at Wrotham, Kent, is the visible sign of long-term experiments in very short wave sound broadcasting which may lead to important changes in British radio.

THE station is situated 730 feet above sea level on Wrotham Hill, about 20 miles south-east of London. The mast is 470 feet high from the ground, and its top section is a 110-foot cylinder, which, with its 32 slots, forms the aerial.

Since July, 1950, the BBC Engineering Division has been making experimental transmissions on three metres—which it regards as very successful.

BETTER SERVICE

If, after further tests at Wrotham, VHF is proved to be of sufficient value and is brought into use in addition to normal wavelengths, it will enable the BBC to give its listeners throughout the British Isles greatly improved coverage and reception. The introduction of regular VHF broadcasting is a matter for Government decision. Meanwhile, the BBC has decided to incorporate VHF aerials in the masts of the ten new television stations, which it proposes to build within the next four years.

The Wrotham station is understood to be the most powerful of its kind in the world. It is the first to make direct side-by-side comparison of two systems of transmission, frequency modulation and amplitude modulation, the system at present used from all BBC transmitters. Each has certain advantages over the other; the chief advantage claimed for FM reception is that it is less liable to interference and fading.

The FM transmitter has a power of twenty-five kW, and operates on a mean carrier frequency of 91.4 Mc (corresponding to a wavelength of 3.28 metres) with a maximum deviation of 75 Kc. The AM transmitter has an unmodulated power of 18 kW, and operates on a carrier frequency of 93.8 Mc, which corresponds to a wavelength of 3.20 metres. Both transmitters are controlled and monitored by one engineer in a single kiosk, which looks out on the transmitter hall.

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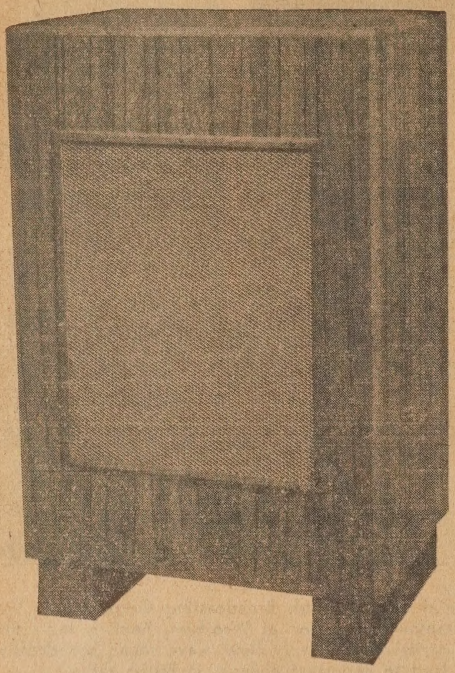

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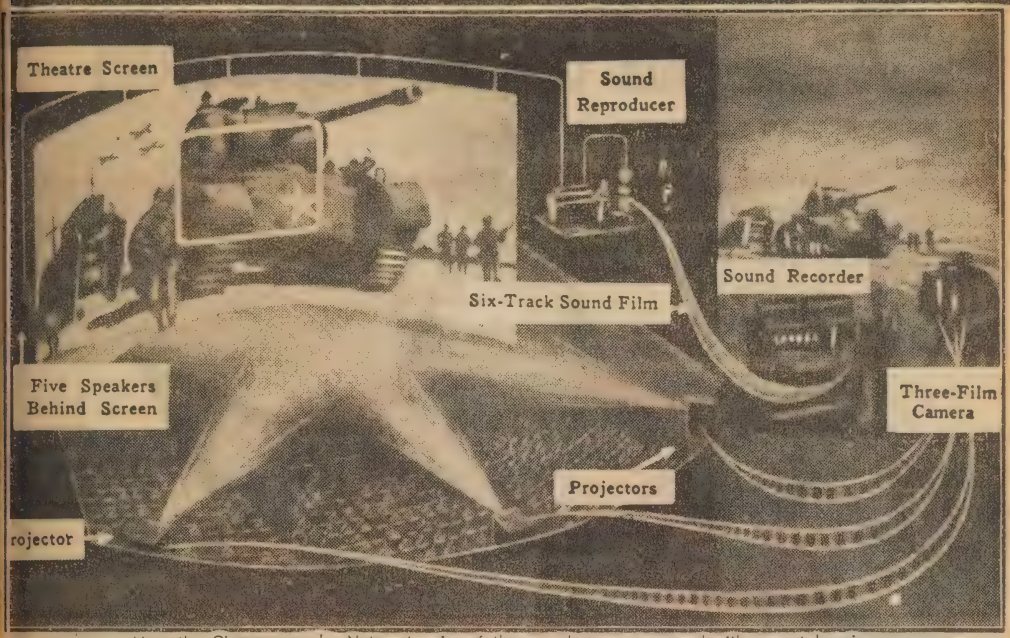
CINEMA REPLIES TO TELEVISION



How the Cinerama works. Note extra size of the curved screen compared with present-day size.

THREE DIMENSION FILMS PLUS WIDE-ANGLE SOUND

A new, wide-angle, three-dimensional film accompanied by high fidelity, multi-source sound is hailed in America as movie-land's answer to the challenge of television. The new movies, it is claimed, actually bring the audience and the projected image together, as the illusion of depth breaks through the flatness of the conventional film of today.

WITH these new movies, everything is different. In the first lace, the screen used is nearly six mes as large in area as the screen sed in the normal theatre. It is lft long and 22½ft high as comared with 24 x 26ft.

Its shape, too, is different. In lace of a flat plane, the new screen concave, so that the audience has ie impression of seeing through a rge, curved bay-window, which inudes a sweep comparable with that en by the human eye.

Because a single camera would be adequate to photograph such a rge area, a three-lens version is sed to cover the full projection idth. The curvature eliminates disrtion which otherwise would be ute with such a wide screen as en by those from almost any point the auditorium.

At the projection end, the three lms are run simultaneously through ree projectors, each covering its vn portion of the screen.

To go with the pictures, a new und system is used, something like alt Disney's set-up for the original showing of Fantasia. Six microphones are used to record the original sound, and in the theatre the six sound tracks—recorded on a separate 35 mm film—are fed to six separate speaker systems installed in various parts of the theatre.

Net result is that you hear the sound from the same direction as the original. If the sound in an outdoor scene comes from behind the camera, it is reproduced by a speaker at the rear of the theatre. Many sounds will of course be reproduced by more than one speaker at a time, which gives the spacial effect so valuable in helping to create the visual illusion of depth.

SOUND SYSTEM

The use of multiple speakers allows the reproduced sound to "travel" from one side of the picture to another just as in fact it did in the original scene. This "stereoscopic" effect isn't new, but has not been developed for the films probably because the impetus to do so was not there. About 1936, Mr. Ray Allsopp, of Sydney, gave a demonstration in a Sydney theatre on these lines, using two complete sound channels, in which the realism was exceptionally good.

Audience reaction to the new movies can best be judged by quoting from some overseas reports.

"Climb behind the pilot of a helicopter as he soars over a carrier somewhere at sea. You lean back as the pilot noses down, you feel the vibration of the engine, and you get slightly dizzy as the deck of the aircraft carrier heaves on the ocean below.

"When the 'Cineramic' camera takes you on a tour, you have the sensations of an actual visit. You turn your head to watch the houses and trees, farmlands and signposts sliding by. A surfboard rider has you riding right along with him. At any moment you expect to be doused with spray."

The army during the war saw the efforts of the inventor in recreation of battle scenes, in which aircraft roared overhead, bombings were carried out, landings made. Aerial gunners were trained on the ground in the actual atmosphere of combat.

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ing to 7-16".

TYPE BH2
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THE ELECTRON—"NEXT TO NOTHING"

An atom of hydrogen is very small indeed, bu t there is somthing which weighs just one 1840th as much. I refer to the electron! Even under the most powerful electron microscopes known to man, the electron remains invisibly small!

by Professor A. M. Low

'T is impossible to "imagine" such a minute thing, and yet it is one of the ost useful known to man. It is proding us daily with entertainment.

New developments suggest that in e very near future it will almost tirely run our factories and homes. is the servant of the future, never mplaining of overwork, wanting no fternoons off."

Yes, this "thing" is an electron. employment in a wide diversity of sks is making a new science of elecnics, a word that will be common morrow.

Billions of them are activated nenever an electric current passes tween two electrodes in a tube om which the air has been exhaust-. They are the servants that perm the "miracles" on our wireless t.

IVISIBLE SERVANTS

We cannot see them, but it is their ipact on the screen which makes the ictures" in television. Tomorrow ey will be lighting our homes, colting the dust from our rooms, reoving the soot from our chimneys d cooking our meals, to mention ly a few applications.

There is no "perhaps" about this. l these things are being done by ese invisible servants today, and it only the threat of war that prevents vast extension of electronic usefulss.

"Electronic" lighting is already inalled in many factories and offices. was invented about 20 years ago, d lamps that would work from the dinary mains were perfected in 1939.

Briefly, how electrons give us light at is three times as cheap and far tter for our eyes than the electric mp we have known so long, is as llows:

When millions of electrons strike rtain chemicals these chemicals give f light or fluoresce. The energy of e electrons excites the chemicals, d by carefully selecting the proporns of zinc silicate, calcium tungate, "codiam" borate and other subances, we can produce a light of most any color we want.

LUORESCENCE

The most useful is one that has all e different colors in the exact prortion of daylight, because this akes everything appear in its atural" colors.

In the ordinary lamp there is far o much red and not enough blue, th the result that colors look differt by artificial light. Fluorescent hting can almost exactly match ylight and women will no longer ve to worry about changing their ake-up when the sun goes down or find it difficult to match threads at night.

The electrons go to work in lamps about five feet long in narrow tubes sometimes containing mercury vapor at low pressure or in small bulbs of almost any shape, with electrons passing in a stream from the electrodes.

In a few years time we shall no doubt see these lamps in every house with benefit to our bills and our eyes. There is one odd thing about this lighting. Since the electrodes usually have to be hot before they discharge electrons, there is a momentary pause after switching on before there is any light, like a wireless set warming up.

Dust collecting will be done by electrons produced by special "valves" or tubes. The principle is quite simple.

We learned at school that oppositely charged particles attract each other. The electrons will convey charges to dust particles as they float in the air, and they will be attracted to little metal plates carrying an opposite charge.

DUST CONTROL

There will not be any dusting to be done, because the process will go on continuously in every room. The device is quite small, requires only a trifle of electricity. In the same way, electrons will collect smoke particles in chimneys and funnels on to metal plates which will be periodically cleaned.

Cooking will be carried out in special ovens of which the vital part will be a vacuum tube generating a high-frequency current. Without going into technicalities, the food will be placed on a shelf so that it becomes the dielectric of a condenser.

Food is a bad conductor, and therefore the energy will have to be dispersed. It disperses itself as heat. Heating occurs in exactly the opposite way to a gas or electric oven, from inside the food outward, and it will be perfectly even.

A complete meal can be cooked in five minutes and the toughest chicken will become tender at the hands of the electronic agents. At the present time these ovens are being used for "cooking" plastic plywood and for other purposes.

Incidentally, this method of cooking in combination with plastic glues may provide a method of "seaming" cloth without stitches.

But electrons are, perhaps, doing their most spectacular work in controlling intricate machines and carrying out delicate tests.

Most television depends upon the fact that electrons can be bent out of the straight path by an electromagnet and a condenser. The amount of bending depends on the strength of the current going into the attractor. On this fact are based instruments that will analyse steels in a quarter of the time usually required, magnify invisible objects up to 100,000 times and tell you the chemical constituents of something that weighs only some millionth of a milligramme!

Electrons are doing all these jobs in factories and laboratories today.

STEEL ANALYSIS

Steel analysis is effected by a variation of television. Instead of the current deciding the path of the electrons being varied by the light and shade of a "picture," it is varied by the resistance of the specimen and this will alter with the smallest change in its constituents.

Suppose you have thousands of pieces of steel and want to know whether they come up to a certain standard. A sample found to be perfect by laborious tests is put in the tester. It produces a "picture" on the screen, the electrons striking it in a "pattern."

Now you have only to put the other samples one by one in the machine and see whether they "fit the picture" to know whether they are the same or not. By coupling this device up with a photo-electric cell and relays, you can turn it into a calculator or sorter, separating different pieces of metal in accordance with the electronic picture they make.

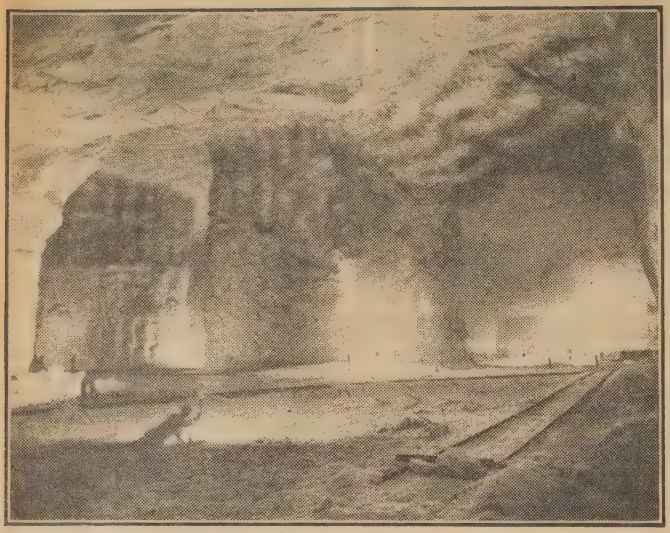
In fact, thousands of rivets and screws have been sorted at high speed in this way in factories.

ELECTRON MICROSCOPE

The high magnification of an electron microscope is secured by using a stream of electrons in place of the ray of light in an ordinary microscope.

Magnetic fields are the lenses, bending the stream of electrons in much the same way as glass lenses bend light. But the electron stream being much "finer" than the light waves is able to show up particles so small that they would be invisible under the most powerful light microscope, simply because the light would pass around the object instead of being reflected.

(Continued on Page 99)



Vastness of world's great salt mines is illustrated here. At Avery Island mines, USA, the corridors of each level have ceilings from 75-90ft high, supported by solid salt pillars 75ft square.

PASS ME THE SALT PLEASE!

Many things are won from the ground besides coal, ore and metals. Take salt—just common salt. It's so common that it is found in both sea and land. Which is just as well because few animals could live without it.

by Calvin Walters

SALT is one of the most sought-after chemicals in the world, for its uses are limitless in both the culinery art and all kinds of industry.

The human body must have salt for its proper functioning. Even life itself depends to a very great extent on the correct intake of salt.

It is a most peculiar fact that, while salt is so important to the human body, and while all of man's essential foods are supplied by Nature in the form of plants and animals, salt is not supplied this way. Man must seek the salt elsewhere, and supply it separately.

In the human body, salt performs several valuable functions. It is absolutely essential to the blood stream, and encourages good circulation and heart action.

SALT AND DIGESTION

In the liver salt promotes the secretion of bile, which in turn assists intestinal digestion. In the gastric juices salt helps in the production of hydrochloric acid, so essential to the digestive processes.

Not many people realise that this acid, commonly called spirits of salts, is produced in the stomach. It does not mean of course that the digestive juice can be used for soldering galganised iron, although the digestive juice can be pretty strong at times.

In the intestinal tract the movement of the intestines, called peristalsis, is stimulated by salt, and the elasticity of the muscles and the water content of the tissues is regulated by it.

AMOUNT VARIES

It will be seen therefore that salt is a vitally important element. The liking of a human being or an animal for salt depends largely on climate and constitution.

In hot humid climates salt is most essential owing to the large quantity lost through excessive perspiration. Soldiers on active service take salt tablets to make up the difference. half cubic miles in bulk. This would be about 14½ times the bulk of t entire continent of Europe abo high water mark.

That is a decent sort of a blo of salt.

The estimate applies only to t open seas. What about all the i land lakes and seas?

The Dead Sea, an area of water Asia Minor 340 square miles, is salty that it contains more than million tons of salt.

All lakes contain large quantiti of salt which is carried down by t rivers and streams.

ROCK SALT

In past ages many of these lak and inland seas dried up, leavi vast deposits of rock salt. These d posits have been covered by laye of soil and rock and held there f use by man throughout the ages.

Some of these deposits are w below the surface and it is oft necessary to bore to very gre depths in order to reach them.

In England in the Middlesborou area there is an extensive deposit rock salt covering about 40 squa miles in area. In this the salt from 50ft to 115ft thick, and

The same remedy is used by thc engaged in hard work requiring mu cular activity.

The amount of salt which a person desires is usually govern by the amount required by the sy tem. That is why some people times will not use the salt pot wh seasoning their salad or other fo while at other times the same pe sons will pour on enough to "si a ship." No two persons are t same in this regard and anim are no exception.

INLAND LAKES

Farmers place blocks of rock s in convenient places so that sto can lick away to their hearts co tent. An animal will not take mc salt than his system requires at t time.

Although salt is so important commodity to man and beast, a Nature does not provide it in t natural food, it is not hard to fir It is one of the most common all elements.

The Encyclopaedia Brittanica sa that if a gallon of sea water co tains a little more than ¼lb of sa there would remain, if the seas dri up, a layer of rock salt four and

oth below the surface varies from ft to 1600ft.

Perhaps the most famous rock salt nes are in Galicia at the mines of eliczka. They extend about six les in one direction and two miles another.

There are underground streets and uares with more than 30 miles of mways. A depth of 12,000ft has en reached in some places.

These mines have been in existce for more than 1000 years and e still working. Inside the great salt lls are chapels, music and dance lls, and fine sculptures worked in e salt.

The technical name for rock salt is alite." All over the world this luable commodity is being dug m mines, some of which pene- ite under great cities.

The method of working the mines similar to that used in coal min- g.

ONSTANT CLIMATE

When the salt is discovered by ring, a shaft is dug and provided ith a hoist and elevator. A descent wn this shaft reveals the different rata of the earth's crust which have veloped over the centuries. Clay, nestone, shale, sandstone, and so .

Perhaps at seven or eight hundred et down the rock salt is reached. ne steps from the elevator into a assive hall cut from the solid salt. is brilliantly lit, and reminds one the scintillating brilliance of an luminated limestone cave.

This mighty hall may be 80ft igh with the roof supported by mas- ve salt columns 50ft square. hese columns must be left to sup- ort the tremendous weight of the oof.

This hall stretches away into the istance with the crystals of salt leaming under the artificial light ke a million jewels.

The air in such a mine is a constant temperature all the year round and is usually very invigorating.

Holes are drilled in the salt face with electric drills and the salt is blasted loose with dynamite. The wall has been previously under-cut with a special machine so that the salt will be able to fall properly after it has been dynamited.

Sometimes the salt is loaded on to a trolley and taken to the shaft for removal to the surface. In other mines the salt is loaded by workers on to a conveyor belt.

The lumps of salt are screened. The small lumps are thus separated from the larger. The latter must be crushed for further treatment.

Workman handles boring drill to prepare for dynamite charge to blast away great chunks of salt.

The rock salt from some mines needs no further treatment because it is very pure. Other deposits are mixed with impurities and must be refined.

Everyone knows that salt is a preserver. Corned meat, pickled pork and so forth are nothing more than meat which has been saturated with salt. Salt fish is known to everyone.

PRESERVATIVE

This use of salt has been handed down throughout the centuries from the time when man used to eat his meat raw. In those days all the meat he caught had to be eaten on the spot. It wouldn't keep.

Then some smart fellow found that when the meat was rubbed over with salt—which he probably got

Open pan process, used in England since Roman times, evaporated brine pumped from underground into shallow pans heated by fires. Salt is raked out at intervals and heaped to dry. Process is known as "walling."

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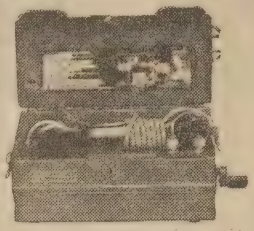

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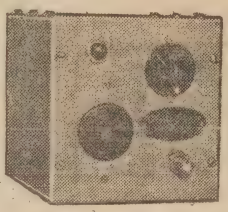

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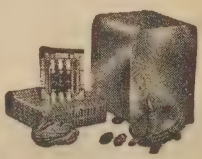

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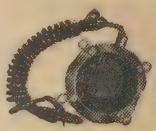

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from a dried up pool at the seaside—the meat would keep much longer.'

When meat is salted the salt is absorbed by the tissues through the moisture present therein.

Vast quantities of salt are used every year by canning companies. Additional millions of tons are used by bakers and pastrycooks, butter factories and cheese factories. The confectionery trade uses salt in large quantities.

This is all in addition to that used in homes for the seasoning of food.

Of course most of this salt is the refined variety produced by evaporation of brine under controlled conditions.

Some of the customs regarding the use of salt have been handed down from past ages.

BIBLE REFERENCES

Throughout the Bible salt is repeatedly mentioned. The best known reference is to Lot's wife who turned into a pillar of salt. If you take a trip to Palestine today and go to the Dead Sea region the guides will point out to you a high pile of chalk and calmly tell you it is Lot's wife.

In the Book of Leviticus the Jews commanded thus, "And every oblation of thy meal offering shalt thou season with salt."

Again in the Book of Ezekiel: "And thou shall bring them before Jehovah and the priests shall pour salt upon them."

To the Jews salt was a symbol of incorruptibility. Perhaps the Covenant of Salt, which is mentioned three times in the Old Testament was the forerunner of the modern idea in some countries of using salt as a symbol for a solemn agreement—a covenant.

When an Arab "swears by his salt," he means to keep his word. The Bedouin tribes of the desert pledged each other's agreement by putting salted bread into each other's mouth saying at the same time, "By this salt and bread I will not betray thee."

OLD CUSTOMS

During the Indian Mutiny many of the Sepoy troops refused to join the mutineers because they had "sworn by their salt" to serve the British.

At the Chinese New Year festivals they throw handfuls of salt on the fire. If it burns brightly it is a good omen for the coming year. This is a good way of always having a good year because salt will always burn brightly with a yellow flame when thrown on the fire.

In Siam two men taking a pledge of friendship drink salted water together in the belief that such an act will make them blood brothers.

In Scotland, so it is said, a Scots couple scatter salt over the new home the night before the wedding. This is supposed to keep witches away and to bring children.

In Sumatra one of the tribes have a most solemn oath, "May my harvest fail, my cattle die, and may I never taste salt again if I do not speak truth."

A native Moroccan always carries a piece of salt with him to ward off evil. Perhaps the old custom of throwing spilled salt over the shoulder to ward off bad luck has its origin in that.

Julius Caesar, when he landed in England in 55 BC, is credited with showing the early English a better way of making salt.

When he landed he found the English pouring brine over hot faggots and then scraping off the salt crust.

SALTER'S GUILD

Julius showed them how to boil the brine in open pans until all the water had evaporated, leaving behind the "pure" salt.

The men of Cheshire used that method for the next 2000 years. In early England salt was the dividing line between high and low rank.

According to their rank a noble host would place his guests "above or below the salt" at the dinner table.

Salt was scarce in those days and the demand for salt exceeded the supply. There was a Salter's Guild in London comprised of men skilled in the art of salt making.

It was the purpose of the nobility at that time to keep salt scarce. This they did by restricting the time devoted to salt making.

Then Mary Queen of Scots started a salt making argument by allowing an Italian to make salt near the Scottish border under the conditions that a heavy tax imposed on it went into her coffers.

Queen Elizabeth of England was a bit annoyed about this and imported a joker named Sellar of Augsburg in Germany with fifteen iron boiling pans to make salt. It wasn't long before there was more salt about than ever before owing to the keen competition between England and Scotland.

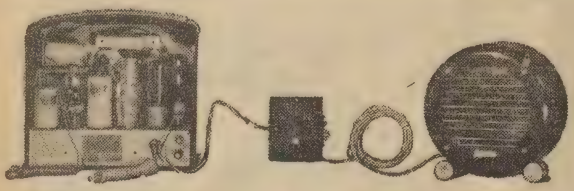
However a high tax was put on the production of salt to keep prices up.

(Continued on Page 100)

WALKIE-TALKIE TELEVISION

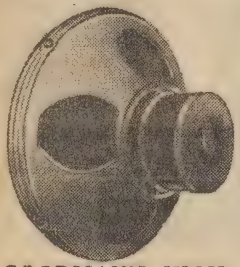
Replacing larger cameras for certain television uses is this battery-operated pack-set transmitter being demonstrated in New York. Complete transmitter weighs 53lb. Antennas for transmitting picture signals and receiving orders from a base station extend from top of pack. Range of unit is about one mile. Camera utilizes sensitive industrial TV camera tube called the Vidicon. On rear of camera case is an electronic finder and built-in microphone for narrator's use.

IF IT'S ANYTHING TO DO WITH RADIO — *it's W.F. for the Best Products, the Best Service*



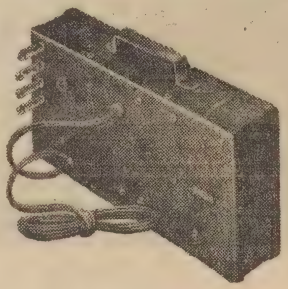
NEW AEGIS EXTENSION SPEAKER & ADAPTOR

Enables easy fitting of an extension speaker to any existing receiver. Speaker in walnut plastic cabinet 94/6; speaker in cream plastic cabinet 97/6; cabinet only, walnut 43/9; cream 48/3; adaptor unit 64/9.



GOODMAN'S HIGH-FIDELITY SPEAKERS

Axiom 150 12" twin cone £19/5/-
Audiom 60 12" single cone £15/10/-



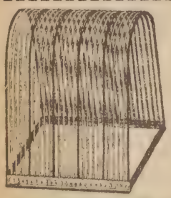
Van Ruyten Portapac

Enables you to use portable radio from AC mains, £10/5/-

Speedier Soldering with "Scope"—the 6-seconds Iron

Operates off 2.5/6.3 volts AC or DC Iron 43/6

Transformers for use off 240V AC 35/-

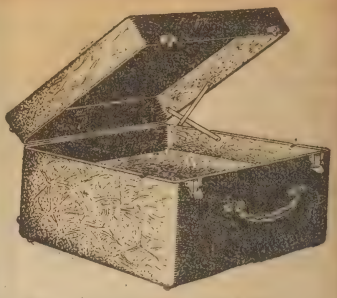


RECORDEX

The new improved Gramo record rack.

- Holds 25 10in or 12in records.
- Engraved easy to read index strip.
- Complete with index card and gummed identification numbers for the records .. 25/-

New model now available to hold 50 records 33/-



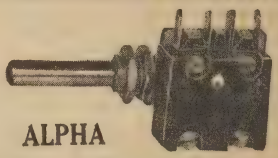
Record Changer Cabinets

Suitable for any make of record changer.
Brown leatherette finish 149/3
Similar but for Record Player 116/-

SWITCH POTENTIOMETERS

½ meg. double pole

I.R.C.	11/6
Plessey	13/-
Egan	10/5
Weestat	12/5



ALPHA Rotary & Toggle Switches

Type R	1 way ..	S.P. ⅜" Neck	5 10
Type A	2 way ..	S.P. ⅜" Neck	5 10
Type B	2 way ..	S.P. ⅞" Neck	9 0
Type C	2 way ..	Semi-Rotary	7 0
Type D	D.P.S.T. ..	⅜" Neck	8 5
Type E	D.P.S.T. ..	Semi-Rotary	10 9
Type F	D.P.S.T. ..	⅜" Neck	10 7
Type G	D.P.D.T. ..	Semi-Rotary	12 4
Type H	D.P.S.T. ..	1" Neck	11 3
Type J	D.P.D.T. ..	1" Neck	13 2
Type L	Door Switch	⅜" Neck	11 3
Type S	Door Switch	⅜" Neck	5 3

GOLDRING HEADMASTER HYPERFIDELITY PICK-UPS

Complete with 3 cartridges, Tonaliser and Transformer £12/15/6
Tonaliser only £3/3/-

WARBURTON FRANKI (MELB.) LTD.

380 BOURKE ST., MELBOURNE, C1. . . . PHONE: MU 6355 (8 LINES)

Trade also supplied *Open Saturday mornings.*

Technical Review

NOVEL INSTRUMENT PLAYS VOCAL QUARTETS

Built originally as a stunt, a simple instrument for four players has proved itself capable of giving real musical enjoyment. According to the author, it will handle everything from simple quartets to Bach chorales.

THE idea was born largely from an engineer's attempt to play a tune by twiddling the knob of an audio oscillator. It led to the development of a simple gas triode oscillator with a resistive control over the output pitch. To the pot. shaft was attached a long arm and a radius scale, such that moving the arm across the scale gave range of about 2½ octaves, which is at least as wide as the human voice.

Success with the first unit led to the production of three others, each one covering a different portion of the spectrum and representing the approximate range of a soprano, alto, tenor and bass voice. The units are arranged so that they plug into one another and occupy the three sides of a card table.

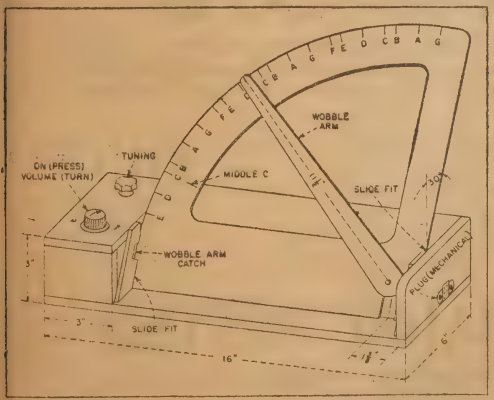
Four players seat themselves around the table and play one part each, the music being conveniently supported on the fourth side. Output from all oscillators is fed to an audio amplifier and speaker system, as shown, and the whole outfit is made readily collapsible.

Experience has shown the necessity for detailed control over each oscillator and acceptable playing techniques have been evolved. In the first place a knob is provided on each oscillator so that they can be readily tuned to one another or to a piano where additional accompaniment is required.

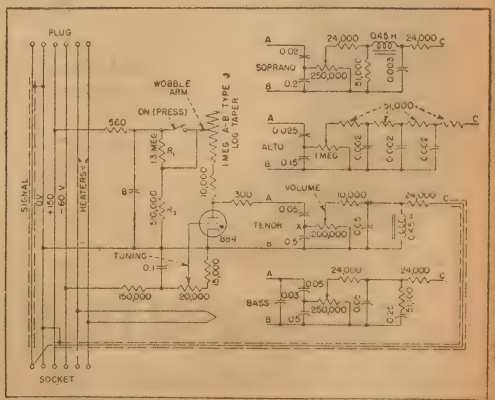
The second knob controls the volume from each oscillator, according to the rotational setting. In addition, the shaft is made to move up and down and continual pressure is required on the knob to maintain output from the oscillator. The instrument can therefore be played with a gliding tone between notes or a distinct break. A single note can be sustained or played "detache", according to the rhythm of the number.

To similate the human voice, or for other effects, the technique is to vibrate the arm either way by about a quarter tone to produce a tremulant effect.—*(Electronics)*

The "Wobble Organ" and its first four players, all members of the Bell Telephone staff.



The bass console. The others are similar mechanically except for the calibration of the quadrant.



Electrical circuit of one of the four consoles. Filament and regulated HT supply comes from the main amplifier.

£2/-/-

Postage and Packing N.S.W. 7/6 Interstate 9/6

I.F.F. MOTORS

rated at 18 Volts DC.
Develops 1/10 H.P.
Operates on as low as 6V.
Converts easily to 240 AC as per R & H December, '49, or Hobbies Illustrated Nov., '50 Revs. at 4200.
Fitted with Gear Box Extended ¼' Shafts giving speeds of 4200, 150, 25, 4 R.P.M. Use a Rheostat and have Variable Speed.

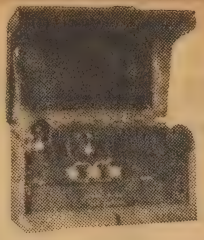
£1/-/-

postage
N.S.W. 4/6
interstate 6/6

PORTABLE TEST SET

Containing 2½ inch 0-50 mill meter, six point key switch &c. in case.

(used equipment.)

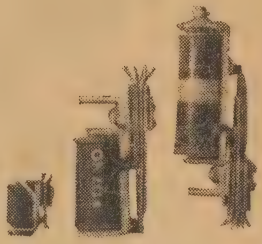


15/-

postage
N.S.W. 5/6
interstate 7/6

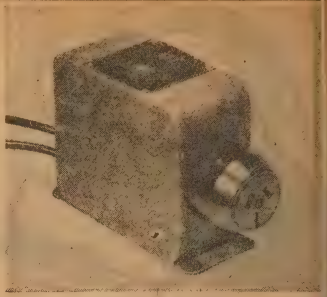
REMOTE CONTROL UNIT

Contains high - grade morse key, buzzer, microphone transformer, 12 point and six point key switches, push button switch, phone jacks terminals &c. Contained in metal case.



AMERICAN RELAYS

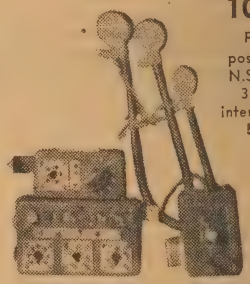
No. 1. Miniature relay 300 ohm coil, S.P.D.T. contacts. **7/6.**
No. 2. Standard relay 250 x 250 ohm coil 4 pole S.T. **7/6.**
2 pole S.T. -- -- -- **6/6.**
No. 3. Standard relay 15,000 ohm coil, 2 pole D.T. -- **12/6.**
All relays suitable for rewinding.



INVERTERS

Input voltage, 6V, 12V, 24V, or 32V, D.C. output 240V, A.C. at 30 watts, 100 cycle. These units are suitable for the operation of any standard 4 valve A.C. receiver from your car battery, home lighting plant or any D.C. supply.

£8/15/-



10/-
pair
postage
N.S.W. 3/6
interstate 5/-

CONTROL BOXES

Containing two 7-pin and one 5-pin heavy duty plugs and sockets, two 20 amp toggle switches, oak six position wafer switch, two fuse holders phone jack &c.

RECORD-PLAYER

Your choice of three popular record players each fitted in highly polished walnut veneered felt lined case and supplied with Ferricart jewel tipped needle which can be used for over 2000 playings.

GARRARD. Fitted with lightweight magnetic plug-in head.
PLESSY. With magnetic head and push button record selector.
COLLARO. With high fidelity crystal head.

£11/15/-
FREIGHT EXTRA

—— ALL FITTED WITH AUTOMATIC STOP ——

METROPOLITAN RADIO SUPPLIES

479 PARRAMATTA RD., LEICHHARDT. PHONE LM3610
AT TOP OF TAVENER'S HILL

Year's problem solved in minutes

The largest and most accurate electronic computer ever built was demonstrated recently at the RCA Princeton Laboratories. Intended mainly to deal with problems of guided projectiles, ships, planes, &c. It is far more accurate and more comprehensive than the types which have hitherto been constructed.

A physicist is shown timing the behavior of the model which goes through all the gyrations of a full-sized missile under actual flight conditions.

DR. C. B. JOLIFFE, who is in charge of the laboratories, explained at the demonstration that the whole development of guided missiles depends on accurate calculation and prediction of their behavior.

The construction of a single experimental missile may entail the expenditure of as much as 100,000 dollars, and, unless its behavior is predicted with a high degree of accuracy, a launching failure may mean the complete loss of the missile and all the instruments which it carries.

With an accurate computer, simulated flight conditions can be varied as many times as necessary until exactly the right behavior is predicted.

4000 VALVES

Constructed under the code title, "Project Typhoon," the analogue calculator employs approximately 4000 valves, miles of intricate wiring, and numerous components accurate to better than one part in 25,000.

The demonstration solved a simulated air defence problem, in which a high speed bomber was attacked by a radar-controlled supersonic rocket-propelled missile.

All information necessary to solve the problem was fed into the machine by means of 100 dials and some of the 6000 plug-in jack connections mounted on the tall panel sections of the computer.

These settings took account of such factors as the aerodynamics of the missile, loss of weight due to fuel consumption, directions fed to the controls by the radar system, the path and velocity of the target and a great deal of other data.

An instant after the computer was set in operation, the circuits began to register quantities like distance, velocity and force. Pens began immediately to trace out a color-coded record of the paths followed by missile and target, right to the point of contact.

A direct visual check on flight paths was provided by an auxiliary device, which gave a three-dimensional picture of the high speed "dog-fight" between the bomber and its relentless pursuer. At the same time, a small-scale model of the missile went through the gyrations that its full-sized brother would describe in free flight, as it obeyed the radar-controlled fins.

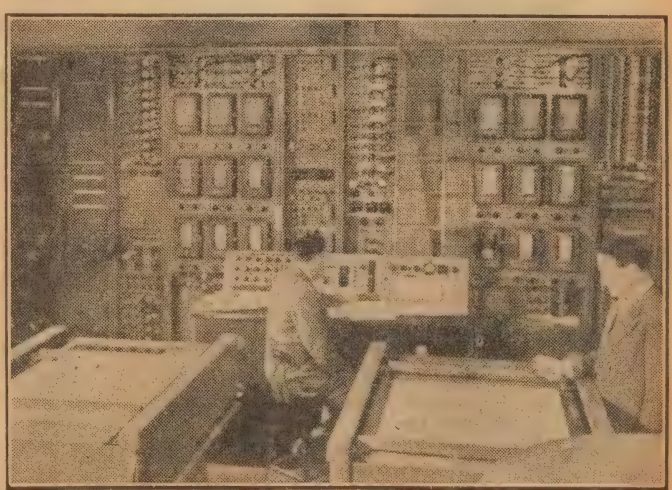
The demonstration stopped after 60 seconds, while engineers explained what factors were right and wrong. Had it been necessary, the machine could have been reset and the flight paths plotted all over again under modified conditions.

In that one minute the machine had provided a continuous automatic answer to 250 additions, 67 multiplications, 30 integrations, and 20 aerodynamic functions. To work out the answer for even one set of conditions—not the infinite number provided by "Typhoon"—would have required the full time attention of two mathematicians for as long as six months.

NEW MULTIPLIER

Heart of the new computer is a new type of electronic multiplier, which combines the features of an analogue device, which may be compared with a slide rule, and a digital device, of which the familiar adding machine is a simple example. The relays in the computer operate in 1-10,000th part of a second.

For complex calculations, a staff of nine mathematicians and engineers is required, in addition to six technicians, to operate the controls. It is housed in a special air-conditioned room which keeps the temperature even at 75 degrees.



The main control console is seen in the centre of the picture, with two plotting tables in the foreground and some of the computer panels at the rear.

SOLVE YOUR PROBLEMS
WITH **TAYLOR** TEST EQUIPMENT

MODEL 47A-P
MUTUAL CONDUCTANCE VALVE AND MULTITESTER

Fitted with large direct reading meter with illuminated dial and OVERLOAD PROTECTION. Tests over 2000 American English and Continental valves including latest types. Filament volts range from 1.1 volts to 117 volts. Filament continuity and element shorts shown directly on meter. Cathode leakage read in megohms. The instrument is housed in a solid oak carrying case and supplied with comprehensive instruction manual. Also available as valve tester minus multitester ranges—Model 45 A-S.

MULTITESTER RANGES. 1000 ohms per volt A.C.-D.C.

D.C. Volts	D.C. Current	A.C. Volts	Resistance
0-120 m.V.	0-0.6 mA	0-3	0.5-22.5-1000 ohms.
0-3	0-6 mA	0-15	50-2250-100,000 ohms.
0-15	0-30 mA	0-150	x 500-22,500-1 megohm.
0-150	0-150 mA	0-300	x 5000-225,000-10 Megohms.
0-300	0-1.5 Amps	0-600	
0-600			x with external battery.

PRICE £41/15/- Plus Sales Tax

IMMEDIATE DELIVERY

MODEL 75A

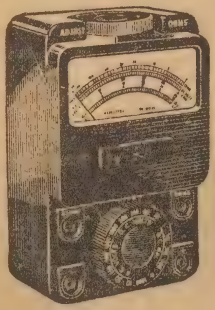
RANGES 20,000 ohms per Volt A.C.—D.C.

D.C. Volts	A.C. Volts	A.C.-D.C. Current	Decibels	Resistance
0—0.1	0—1	0—50 uA	—30 to —5	1—50—10,000 ohms
0—2.5	0—2.5	0—5 mA	—22 to +3	1000—50,000—10 Megohms
0—10	0—10	0—50 mA	—10 to +15	*10,000—500,000—100 Megohms
0—50	0—50	0—500 mA	+4 to +29	
0—250	0—250	0—5 Amps	+18 to +43	*With external battery.
0—1000	0—1000		+30 to +55	

This is a robust 20,000 ohms per volt 50 range universal multimeter designed for accuracy and stability. Fitted into an attractive case, the meter is provided with instantaneous OVERLOAD PROTECTION. The clear, easy to read scale has a length of 4 inches. An internal buzzer is provided for quick continuity tests. Complete with test leads

PRICE £19/17/6 Plus Sales Tax

MODEL 120A POCKET MULTIMETER



RANGES 1000 ohms per volt A.C.—D.C.

D.C. Volts	D.C. mA	A.C. Volts	Resistance
0—0.25	0—1	0—10	0.5—20—2000 ohms
0—10	0—10	0—50	50—2000—200,000 ohms
0—50	0—50	0—250	*500—20,000—2 Megohms
0—250	0—500	0—500	*5000—200,000—20 Megohms
0—500		0—1000	
0—1000		0—2500	*With external battery.
0—2500			

This is an accurate pocket size instrument using a robust, sensitive meter movement fitted with instantaneous OVERLOAD PROTECTION and is housed in a high grade moulded case. All resistors used for voltage and current ranges are adjusted to an accuracy of 1%. Supplied complete with test leads.

PRICE £10/10/- Plus Sales Tax

DIMENSIONS: $4\frac{7}{8}$" x $3\frac{1}{8}$" x 2"

Australian Distributors:

JACOBY MITCHELL & CO. PTY. LTD.

MA5475—MA5058

Sales and Showrooms, 277 Clarence Street, Sydney.

SA: GERARD & GOODMAN LTD., 192-196 Rundle St., Adelaide.
Queensland: CHANDLERS PTY. LTD., Cnr. Albert & Charlotte Sts., Brisbane.
Victoria: J. H. MAGRATH & CO., 208 Little Lonsdale St., Melbourne.
NSW: JOHN MARTIN PTY. LTD., 116 Clarence St., Sydney.

Taylor — Best for TEST EQUIPMENT

Manufactured by:—TAYLOR ELECTRICAL INSTRUMENTS LTD., GREAT BRITAIN

TV EXTENDS MICROSCOPE'S RANGE

A new technique involving a color sensitive television camera tube has enormously increased the range and versatility of the ordinary light microscope. Images hitherto visible only to one eye can be amplified and viewed through a television channel by as many viewers as necessary, even at distant points.

DEVELOPED at the RCA laboratory, the technique involves mounting one of the small "Vidicon" camera tubes in a suitable assembly above the eyepiece of a standard high-powered light microscope.

The image is scanned by ordinary television techniques and can be fed out to as many viewing systems as required. The possibilities of the scheme for lecture work are obvious.

By using two tubes mounted side by side the effects of binocular vision can be obtained, the two tubes scanning the object through the two normal optical systems. The housing for the tubes is no larger than a small 16mm movie camera.

SPECIAL ADVANTAGES

Quite apart from the possibilities of lecture work, the technique offers important advantages over direct viewing. Many components of living cells can be made visible only by the killing and staining technique. When using the Vidicon camera tube, it is possible to construct tubes sensitive to specific portions of the light spectrum and to observe directly the motions of the living cell.

The clarity of the image can be further enhanced in many cases by manipulating the brightness and contrast controls at the viewing position.

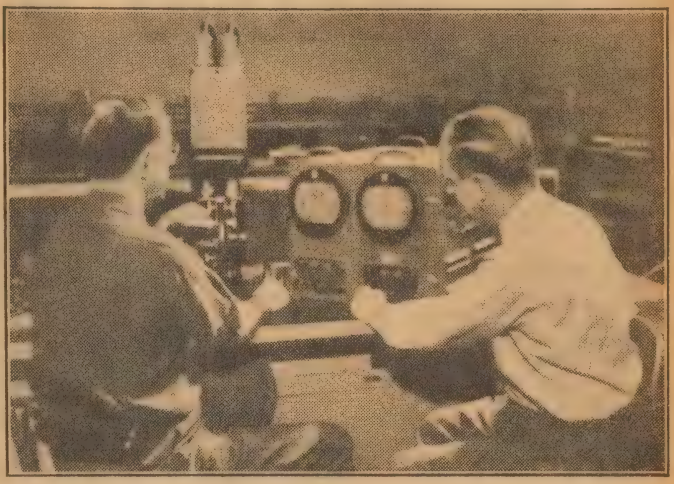
According to Dr. Parpart, RCA biology expert, red-sensitive and violet-sensitive tubes have been tested. It is practical to view the specimen simultaneously through each, by using the binocular technique, and a very complete picture is obtained of the cell's behavior.

EFFECT OF COLOR

Dr. Parpart explained that with the color-sensitive tubes it is possible to select a narrow light waveband wherein lies the light absorption characteristics of the particular cellular material to be studied.

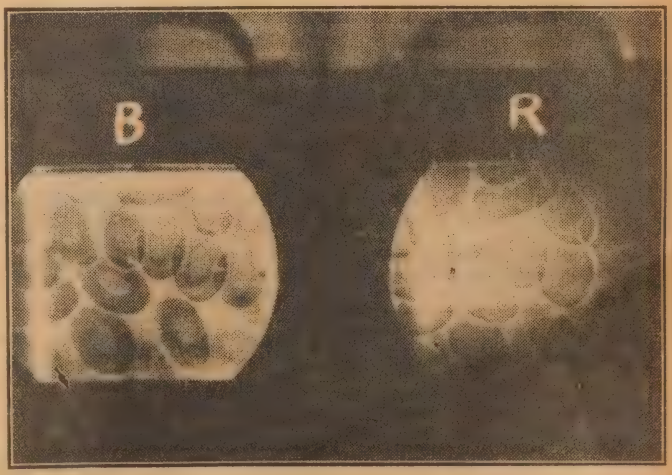
The degree of contrast between the particular components within the cell is much superior to that previously gained by the tedious method of photographing the specimen through color filters. In fact, some granules in living cells have been observed for the first time using the new method.

In the study of movement in living cells, motion picture photography has suffered the limitation that extreme lighting is required, which often causes damage to the cells. The television technique operates at very much lower light levels and does not suffer this disadvantage.



Dr. A. K. Parpart (left) and L. E. Flory demonstrate the Television-Microscope combination which permits direct observation of living cells.

Dr. Parpart stated: "It has been possible to observe certain microscopic particles in cells in active Brownian motion that have not been observed before; it has been possible to expose various egg cells, red cells and plant cells to light of different wavelengths and thus be able to study at a particular wavelength, details of cellular structure that are not clear or not observable visually.



Photographs of cell structure as revealed on screens of cathode ray tubes showing definition of the magnified images after exposure to vidicon camera tubes which have been made sensitive to light from the blue (B) and red (R) portions of the light spectrum.

THREE-SPEED HIGH FIDELITY RECORD PLAYER

Goldring

THE GOLDRING THREE-WAY PICKUP (No. 150)

HIGHEST FIDELITY REPRODUCTION.
Easy change from 78 rpm to 33 1/3 and 45 rpm by simply changing color coded stylus and moving weight adjustment.

OUTPUT
150 mV.

FREQUENCY RANGE
30—16,000cps

STYLUS PRESSURE
14 grms (78 rpm)
7 grms (33 1/3 rpm)

OPTIMUM LOAD
50,000 ohms

SAPPHIRE STYLI (supplied with PLAYER)

BLUE
0.003" for Standard Records

YELLOW
0.001" for 33 1/3 rpm Records.

REPLACEMENT STYLI
16/6 each

PLEASE NOTE: The unique design of this PICK-UP using stylus as ARMATURE does not permit use of other styli or needles.

MAIN FEATURES:

THE B.S.R. (BIRMINGHAM SOUND REPRODUCERS)

THREE-SPEED MOTOR M.U.14

- SPEED CHANGE by simply turning a knob.
- IDEAL FOR ALL TYPES OF RECORDS — standard or long playing (microgroove).
- The GOLDRING THREE-WAY PICKUP (No. 150) regarded by many experts as the greatest advance in pickup design.
- BEST QUALITY LEATHERETTE Covered Case can be closed when playing 12" records.
- Independent on-off switch.
- EASY PLUG-IN TO MAINS.

Motors by B.S.R. (Birmingham Sound Reproducers) enjoy a world-wide reputation for quality and reliability. Goldring are proud to incorporate the latest and most up-to-date B.S.R. MOTOR—THE THREE-SPEED MOTOR UNIT M.U.14 in this record player.

The ingenious and simple method of speed change is positive and smooth of action. It is achieved simply, by a movement of the speed change knob.

No belts of any type are used, a fact which greatly adds to reliability and eliminates the inherent 'wow' defects of the belt type of three-speed motor.

Smoothness of action is assured by employing the B.S.R. de luxe 4 pole motor which is noted for its low rumble and vibration factor.

Design of suitable pre-amplifier and equaliser supplied with each player.

PRICE: £21/10/- (Incl. 25% Sales Tax)
(Interstate slightly higher)

GOLDRING ENGINEERING (A/SIA) PTY. LTD., 57 H.E. AREA, ST. MARY'S, N.S.W.
Phone: St. Mary's 447. After Business Hours, UW6907

NEWS AND VIEWS OF THE MONTH

Glass heats house

A BLACK glass that can heat a house by capturing the radiations of the sun was described recently in the United States.

It is one of the many new kinds of glass reported on at the 43rd annual American Institute of Chemical Engineers.

Scientists who developed the black glass note that most of the energy from the sun is now wasted. It could, however, provide heat for homes with the use of the new glass, they say.

The heating device consists of a group of partially blackened, overlapping glass plates. These are mounted on the roof of the house, similar to the way shingles are arranged. The plates are separated by small air spaces. A glass cover over the staggered plates keeps out dirt.

The black glass surfaces become heated when exposed to sunlight. Air passing between the plates is warmed by the captured heat of the sun and forced into the house. A roof-top solar heating system now can be designed to supply 60 per cent of the energy required for heating a home, the scientists point out.

Other scientists explained how a lightweight glass filled with tiny air bubbles can be used as a fireproof insulating material.

Another new glass, which has a high conductivity, can be used in windows of aeroplanes, locomotives and ships to help keep the windows free of fog and ice.

Taxi radio

LATEST application of two-way mobile radio communication in Sydney is its installation in taxi-cabs.

It may become a reality soon, following the approval of Road Transport authorities.

One of the conditions will be that the taxi-cab must come to a stop before using its transmitter. This proviso is in the interests of safety, as it might be dangerous to operate and drive at the same time.

The radio service, although expensive, should greatly improve the efficiency and earning ability of taxi-cabs. It should also be valuable in emergencies where quickly-available transport might save lives.

Radar tracks meteors

NEW ZEALAND scientists are working on a radar project to form a complete picture of meteor activity in the Southern Hemisphere.

The project will involve several years work in a special field station in Canterbury.

Funds provided by the NZ Government for the work have now been supplemented by a £600 grant from the Nuffield Foundation.

In addition, complete automatic recording equipment has been sent from Manchester University, and a grant of £400 has been made by the NZ University Research Committee for electronic test equipment.

Detailed information on properties of the atmosphere at 60 miles above the earth would directly affect short-wave radio communication.

To the moon soon

CIRCUMNAVIGATION of the moon by powerful rockets with human crews is predicted within the lifetime of persons living by chief scientist of the Radio Research Board of the SCIRO, Dr. D. F. Martyn.

He said a space station from 10,000 to 25,000 miles from the earth was possible.

Dr. Martyn has been awarded the Walter Burfitt Medal and Prize by the Royal Society of NSW for "outstanding researches in ionosphere."

He works at the Commonwealth Observatory, Mt. Stromlo, near Canberra.

"These things are no longer a dream, but a practicability," he declared.

"We have the technical knowledge necessary to be able to fire a space ship or station up to 25,000 miles

POPULAR SCIENCE QUIZ

Q. In an everyday discussion on the moon, what would be some of the main points?

A. Our moon is 2160 miles in diameter and is spaced from the earth by about 240,000 miles. The rays from the sun, reflected back to earth by the surface of the moon are responsible for moonlight. When the earth casts a shadow over part of the moon, we see only the familiar meniscus shape, commonly referred to as a "new moon."

The moon revolves around the earth once in every 29½ days, rotating on its own axis at the same time. In so doing, it always presents the same face to the earth, thus explaining why we can always see the "man in the moon" when it approaches what we call "full moon." This so-called "man in the moon" is merely a configuration of the surface irregularities, showing up as shaded areas.

During each lunar month, a mythical observer on the moon would experience one night and one day, each of about two weeks in duration. It appears that the moon's surface is extremely cold during the "night" period, some figures quoted mentioning 460 degrees below zero. No sign of life has been detected on the moon.

Q. The human body is unable to exist without air. What is air composed of?

A. Many investigations have been made into the composition of air and measurements taken of the percentage of the component gases. It has been established that about 20 pc of the air we breathe is oxygen and about 78 pc is nitrogen.

Other gases like argon, neon and helium account for about one pc, while carbon dioxide and a small amount of water vapor account for the other one pc.

Other components are often present which are not gases and not associated chemically. For instance, there will be varying amounts of dust, bacteria and other finely divided particles. The human nose filters a certain amount of this from the air as it is inhaled.

Q. Although water is possibly one of the most common elements, what do we really know about it?

A. To the scientist or chemist, water is known as the "perfect" solvent. Stated concisely, however, water is a tasteless, colorless and odorless liquid, which can exist in three states, solid, liquid and gas. A single molecule of water consists of two hydrogen atoms and one oxygen atom, which means that, in a given volume there are two parts of hydrogen and one part of oxygen. Water can be divided into these component parts by adding an amount of sulphuric acid and passing an electric current through the solution.

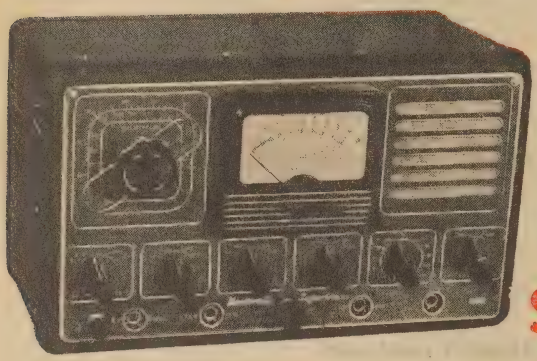
To the housewife, water is normally divided into two categories, "soft" and "hard," the former being usually preferred. Fresh rain water or distilled water will dissolve soap easily to form rich foamy suds. It is known as "soft" for this reason. Water, which contains certain chemicals in the mineral group is known as "hard" and will not easily form a lather with soap.

ACCURATE....

VERSATILE....

SPEEDY....

RELIABLE....



The UNIVERSITY Model AST SUPERTRACER

This is the most modern, up-to-date, and efficient service instrument that anyone could desire. It is easy to use and gives rapid and accurate location of faults in radio receivers and similar equipment. It speeds up testing, servicing, and production, and will rapidly detect faults which render a receiver inoperative, or which make it intermittent or lacking in sensitivity, or which cause oscillation distortion, or hum.

The instrument comprises a two-stage tuned R.F. amplifier, a diode detector, and two-stage A.F. amplifier and, of course, a loudspeaker and power supply. In addition, a vacuum tube voltmeter measuring up to 500 volts A.C. or D.C. at a resistance of 11 megohms on D.C. and 10 megohms on A.C. is provided. The tuning range of the R.F. circuits is 175 to 490 K.C., 550 to 1550 K.C., 1.5 to 4 megacycles, and 6.3 to 18 megacycles. R.F. sensitivity is such that input voltage of the order of a few millivolts may be detected on all ranges, so that the instrument is suitable for use in any district where alternating power mains are available. A capacity type R.F. multiplier in the input circuits in conjunction with the V.T.V.M. enables stage gain measurements to be made.

TEST PROBES: The R.F. test probe is fitted internally with a very small series capacity of a few micro-microfads, so that it does not produce an appreciable detuning effect when applied to the grid or plate of R.F. or I.F. stages in a receiver. The A.F. test probe is a conventional shielded lead for feeding A.F. into the tracer or A.F. out from the tracer for testing A.F. amplifiers or speakers. The D.C. probe contains a series 1 meg isolating resistor, so that the V.T.V.M. may be used to measure plate bias or A.V.C. voltage under actual operating conditions without disturbing the action of a receiver.

VACUUM TUBE VOLTMETER: The V.T.V.M. features a centre zero scale for direct voltage measurement, so that voltages which are either positive or negative with respect to a receiver's chassis are instantly indicated without the necessity of reversing test leads or operating a reversing switch. Zero is at the left for alternating voltage ranges, and operation covers the audio frequency range. Voltage ranges are 0/5, 0/25, 0/100, and 0/500 volts at an input resistance of 11 megohms on D.C. and 10 megohms on A.C. ranges. In conjunction with the amplifying stages of the tracer, the meter will indicate R.F. or A.F. voltages down to a value of less than 1 millivolt. Indications are provided by a large, clearly marked rectangular meter with illuminated scale fitted in an attractive modern plastic case measuring $4\frac{3}{4}$" x 4". The V.T.V.M. and tracer may be used simultaneously for observing signals at two distinct points in a receiver. This feature greatly facilitates location of intermittent faults. Operates from A.C. 220 to 260 volts.

RADIO & ELECTRONIC TEST EQUIPMENT

University

Made by University Graham Instrument Co., 5 North York St., Sydney 'Phone BU3169 (2 lines).

om the earth and hold it there or any length of time.

"Such a station would be equipped ith instruments which would enable s to achieve things we have never nown before."

Dr. Martyn said the first step oward a trip to the moon would be uccessful circumnavigation of the oon by a remote-controlled space hip.

Money for nothing

HOW would you like to earn £1000 for just "walking on" and saying nothing?

That's how Joan Bennet, film tar, collected her cash recently efore American TV cameras. It is n indication of the lavish spending n the new entertainment and the inancial backing it commands.

Ann Sheridan, in a brief appearance, earned £1500, Pat O'Brien got 1000 for saying "I'm glad to be ere," and Lauritz Melchior £1250 or one song.

It is reported that TV stations n New York have no more time o sell at any price for months to ome, and big advertisers are constant bidders for what is available. Networks claim now to command an udience of 50 million people.

Zenon anaesthetic

A GAS used in the illuminated signs of Broadway has been found valuable as an anaesthetic.

This gas (Xenon) has already been used in four surgical operations.

Dr. Stuart Cullen, professor of anaesthetics at the University of Iowa, has reported that Xenon, being non-inflammable, is much safer to administer than many anaesthetic gases currently used.

"Although the danger is well controlled it is necessary to take every precaution with inflammable anaesthetics," he said.

Dr. Cullen reports that Xenon produces its anaesthetic effects rapidly and the patient's recovery is also rapid.

Two of the four patients on whom Xenon was used became alert a few minutes after the operation.

Xenon is not a new discovery. It is one of the components of ordinary air and was isolated in 1898.

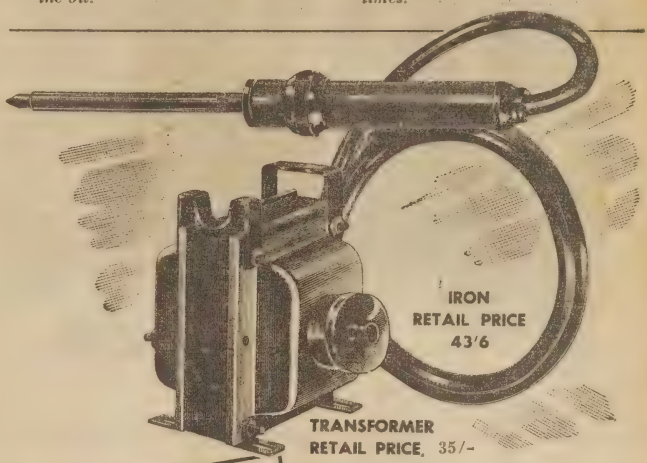
High-speed photos

WE were impressed recently with a published photograph of a grounded aircraft taken from another machine travelling above it at 500 mph and only 100ft altitude.

At first glance, the task of making a sharp, clear picture at such a speed would appear impossible. It was done by a film moving across a small slit in place of a shutter, and at the same speed as the aircraft itself. The procedure isn't new, but this doesn't detract from the amazing achievement of timing and camera technique.

CHECK THESE FEATURES!

- *Operates from 2.5 6.3 volts A.C. or D.C. or from mains with transformer.*
- *Heats up from cold to ready-for-continuous use in only 6 seconds.*
- *Has an efficiency equal to that of irons rated up to 150 watts.*
- *Weighs only 3½ ounces and is 10 inches long.*
- *Can be used in conjunction with a transformer from A.C. mains or from any suitable car battery.*
- *Has low operating cost—no current is consumed when not in use; no frequent cleaning and tinning of the bit.*
- *Extremely suitable for heavy or delicate soldering—heat is applied only where and when it is required.*
- *Simple to operate — merely press switch ring forward and the iron is hot in six seconds.*
- *Maintenance is simple — elements and replacement tips are fitted easily and without delay. Replacements are screwed in and cost only a few pence.*
- *Fully guaranteed for three months from date of purchase. A maintenance service is available at all times.*



SCOPE

THE SOLDERING IRON THAT
HEATS FOR CONTINUOUS USE IN
6 SECONDS

Scope is a new type soldering iron that gives amazing soldering speeds while operating from low voltages, even on the biggest jobs of work. To really appreciate the value of Scope you should see it demonstrated. It may be connected to a 6-volt car battery or, through a suitable transformer, to 240 volts A.C. To use, you merely push the switch ring forward with a light thumb pressure, and in six seconds the soldering tip is hot—ready for use with an efficiency equal to that given by other irons with ratings up to 150 watts. Scope gives modern efficiency and low cost, long-life soldering. See it demonstrated and you, too, will agree it is the best soldering iron value to-day.

★ ★ ★

You should see and test Scope for yourself. If you do this, you will agree it is the soldering iron you should and must have. Ring, write or call for illustrated pamphlet and a demonstration.

Australian and Overseas Agents:

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Bradbury House, 55 York Street, Sydney. 'Phone: BX 2508.

MANUFACTURED BY SCOPE LABORATORIES, MELBOURNE, VICTORIA

S.10.40

Complete equipment shows amplifier and record changer mounted on a top shelf with record storage space beneath. Ventilation slots cut in the back allow air to flow through record compartments, over amplifier and out the back.

INSTALLING A PA SYSTEM

This article describes a complete factory public address system suitable for paging and for "music-while-you-work." It discusses such problems as audio power requirements, speaker placement and coverage, adjustment of levels and impedance matching. Built and installed by our technical staff, the system described here is operating with marked success in a factory operated by our parent company.

EXTENSIVE surveys have shown that music-while-you-work provides valuable relief in factories from the tedium of repetition work. The effect of well-chosen and well-timed sessions is generally reflected by increased production and greater contentment, making outlay on a PA system a good investment.

If the installation can be used at the same time for a discreet amount of paging it assumes additional value.

In planning a PA system many problems have to be faced and, to a certain extent, each installation has to be tackled on its own merits.

The most important single factor is the prevailing noise level in the factory. This may vary from a low background to a clamor so great that one needs to shout in order to be heard.

Where the noise attains such extreme proportions the whole idea of music-while-you-work has doubtful virtue because the softer passages will not be heard and the loud ones may easily cause as much annoyance as anything else. However, this would be an exceptional case, efforts being made in most factories to keep the prevailing noise to a more moderate level.

LOW BACKGROUND

We were more fortunate with the installation described here in that the general background was quite low, most of the noise coming from large air-circulating fans. It goes without saying that much less audio power is required for a given area under quiet conditions than would otherwise be the case.

The type of speakers used, and their placement, is of major importance. The obvious alternatives are to operate a small number of speakers at high level or a large number of speakers at a relatively low level. A word of explanation may be in order.

The first system can be successful in buildings or rooms of regular shape and having a high ceiling. Properly placed, a central speaker system should diffuse the sound more or less evenly, without creating "hot" spots where the level is too high for comfort.

SPEAKERS NEEDED

In a relatively small area, as in a room 30 or 40 feet square, a single 12-inch speaker in a chandelier-type housing would be adequate. Even a speaker mounted near the ceiling on a vertical baffle would suffice.

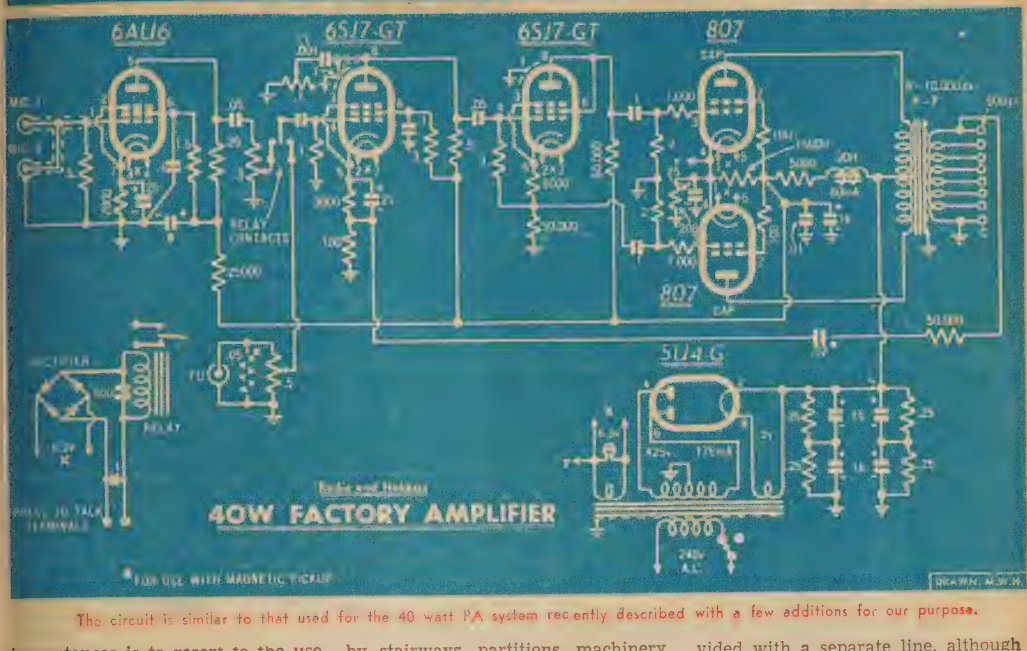
The nominal power required may vary from one to three watts, depending on the prevailing noise level.

In a larger space, ranging up to, say, 150,000 cubic feet, the nominal power required might run up to 25 watts. To handle this amount of power, and also to give 360-degree coverage, the obvious choice would be four 12-inch speakers mounted either on baffles or in small cabinets, each speaker facing outwards from the cluster and inclined slightly forward.

Still larger buildings, like major assembly halls, &c., would call for an increase in audio power or, better still, the provision of the more efficient horn-type speakers. There are difficulties, however, about high-powered central systems, not the least being the risk of antagonising people in adjoining homes. The sound may also penetrate administrative offices, being far more distracting than ordinary factory noise.

The better approach under such

CIRCUIT DIAGRAM OF A PA SYSTEM AMPLIFIER



The circuit is similar to that used for the 40 watt PA system recently described with a few additions for our purpose.

circumstances is to resort to the use of many speakers operating at low level and strategically placed near working bays.

By way of illustration, the factory with which we were concerned, excluding the areas not to be covered, resolved into a space approximating 140,000 cubic feet. It was freely broken up, however, by an open mezzanine floor, by partitions, landings, and so on, making a centralised installation impossible.

The treatment accorded the various sections may be enlightening and, with this in mind, a simplified ground plan is shown.

DISTRIBUTION

Along one wall is a narrow section for specialised work. It is completely partitioned off and measures barely 7ft wide by about 20ft high. Three 12-inch speakers were installed in this room, being mounted on 3ft baffles screwed to the ceiling rafters and facing downward.

Since these speakers would obviously need to operate only at very low level, they were wired across a separate line running away to the amplifier and branded as "Line 1."

To serve the main body of the factory, three more 12-inch speakers were mounted in commercial open-back box baffles. The boxes were hung high up on the partition with the face of the speakers inclined slightly downward.

These three speakers, which would obviously need to run at a higher level, were allotted to line 2, for separate connection to the amplifier.

The mezzanine floor, as shown dotted, creates two large areas which are partially isolated from the main hall by stairways, partitions, machinery, and so on. The ceiling height above and below the floor is barely ten feet, creating the problem of a large floor space, low ceiling and local obstructions.

The treatment here was to disperse no less than six speakers in each section, each speaker being mounted on a flat baffle attached to the ceiling rafters and facing vertically downward. It would have been possible to mount some of the speakers in the ceiling and obtain an infinite baffle effect, but this would have left them open to damage by dirt and rats.

Since the speakers would operate at very low level, only 8-inch types were installed.

A possible criticism of such an arrangement is that the sound level is higher immediately below any one speaker but this can be eliminated by using a chandelier type mounting or, more cheaply, by installing a small diffusing plate below the baffle opening.

We simply staggered the speakers sufficiently to avoid having them immediately above the fixed work positions.

Each bank of speakers was provided with a separate line, although one line carried an extra box-mounted speaker to cover a small area near the edge of the mezzanine floor.

Finally, provision had to be made also for two rooms off one end of the main hall and these were provided with 12-inch speakers mounted on three-feet baffles hung vertically from a ceiling rafter. A common line was used for these two to avoid unnecessary duplication of wiring.

Had it been necessary to alter the relative levels of these two speakers, adjustment could have been effected by fitting them with transformers of different impedance.

It will be noted that the baffling arrangement throughout is quite modest, but there is good reason for this. While the reproduction from a factory PA system should be free from obvious distortion, high fidelity sound is impossible under noisy conditions and even undesirable where the music is intended purely as an unobtrusive background to work.

POWER OUTPUT

Coming to the matter of power output and referring back to figures already quoted, it appeared that a nominal 25 watts would more than meet requirements, in view of the low prevailing noise level.

Allowing a safe margin for increased noise or possible extensions, we elected to use the 40-watt PA amplifier which was described in the June, 1950, issue. Anyone interested in building this amplifier would be well advised to borrow the original issue and read the full story.

The original amplifier was built on a special chassis measuring 17½ x 8½

A SIMPLE radio tuner could be used as the alternative program source to a record changer and pickup. Obvious choice would be a two-valve superhet tuner drawing its supply from the main amplifier. A circuit for a suitable tuner is available through the query service Many radio stations run special music-while-you-work programs.

Build your own INVERTER UNIT!

240V. AC/DC Inverters now available in Kit Form

Beat the blackouts with a power supply you can really depend upon. This 240V AC/DC Inverter unit will operate many electrical devices in your home or shop. It can be easily connected to an ordinary 6 or 12V battery, transforming **direct** current into 240V **alternating** current. It is all that is required to operate the average 4-valve mantel set (or 5-valve sets for short periods), radio test equipment, barbers' hair clippers, electric dry shavers—in fact any piece of non-synchronous AC/DC equipment rated at 30 watts or less.

An AC/DC inverter enables you to take your AC mantel set away on holidays, picnics, camping, etc., and allows country people with 32 volt home lighting plants to use ordinary small AC radios.

Available for 6 volt, 12 volt and 32 volt operation, complete with battery lead, 3-pin socket as illustrated. Size (excuding socket) 4¼" x 3¾" x 4¾" high. Weight 5½lb. Finish: Attractive grey brocade.

Place your order early—supplies are limited.

Kit of parts £6/18/-
Plus postage

Completely built unit £8/16/10
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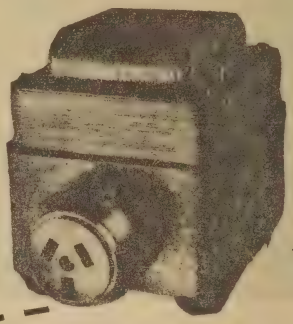
(Postage: N.S.W., 2/9; Other States, 4/6.)

Operates:

★ **RADIOS**
★ **SHAVERS**
★ **HAIR CLIPPERS ETC.**

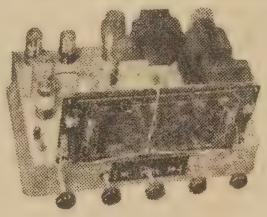
from Batteries



E.P. KITSETS

The Electronic Parts range of Kitsets includes models for every purpose. There are A.C. receivers, both mantel and console, and radiograms, there are vibrator sets, battery sets and 32 volt receivers for the countryman; there are car radios. Electronic Parts can supply you with a kitset for the smallest crystal set—or a magnificent radiogram. Every circuit is well tested and proved . . . many have been featured in the pages of "Radio & Hobbies."

Write to Electronic Parts for their Kitset catalogue. It will be sent without obligation.



- **Fun to build**
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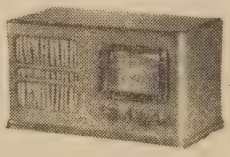
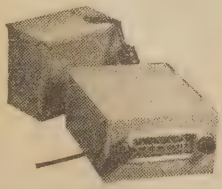
Senior Portable: A handy set for bush or beach. Delightful tone — good range.



Fireside 5: A mantel set for any home . . . complete with attractive leatherette covered cabinet.



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Please send me, without obligation on my part, details of your range of high quality kit-sets.

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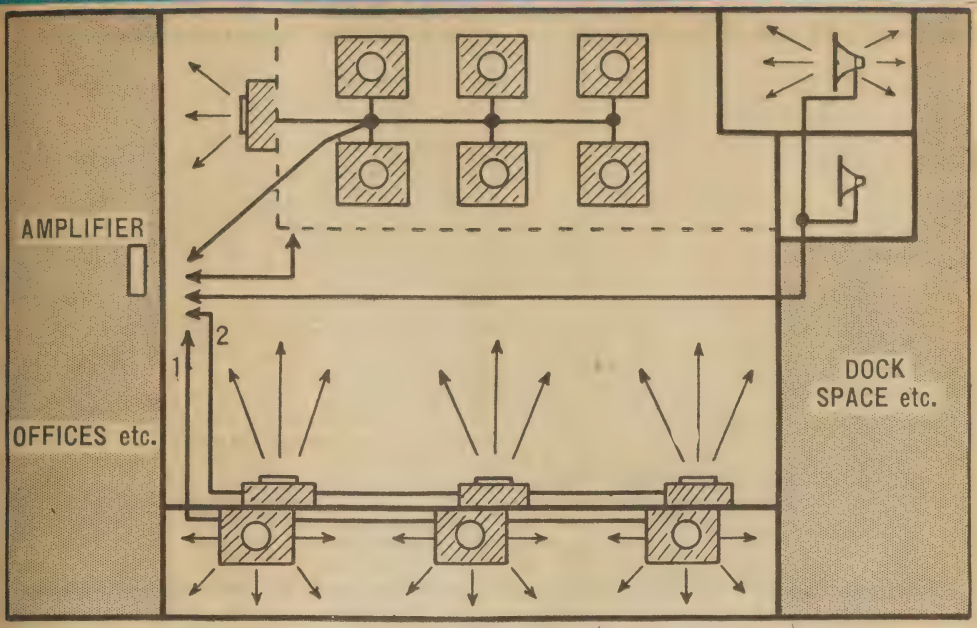
TYPICAL FACTORY LAY OUT FOR SPEAKERS



Power distribution to loudspeakers is a vital link in the chain. This diagram shows a method by which it can be done.

c 3 inches, with a sloping front panel for the controls.

It had two parallel input jacks for microphone, the pre-amplifier being a 6AU6 miniature pentode. To avoid risk of microphony, this valve, together with its shield and socket, was mounted on a small plate, insulated from the main chassis by rubber grommets. Flexible wires connected the socket to the associated components.

The output from this valve fed through a mixer system to a 6SJ7-GT pentode, the pickup input also being introduced at this point.

Another 6SJ7-GT served as phase splitter, feeding two push-pull 807 valves in the output, operated as tetrodes with feedback to the cathode of the first 6SJ7-GT.

For the output transformer we used a type having a 10,000-ohm primary and 500-ohm secondary with a variety of intermediate output tappings. Purpose of this was to match the variety of speaker hookups likely to be encountered in everyday PA work.

POWER SUPPLY

The power supply was conventional, apart from the use of series-parallel filter condensers to give added safety against breakdown.

In adapting this amplifier for the factory system the mixing facilities were obviously not required, normal practice being merely to switch from one input to the other. It had been decided already to provide only a record-changer for music and all that was required was a switch to change from pickup to microphone.

It was envisaged that the attendant would merely load the record-changer with the appropriate number of records and then forget it for the next half-hour. Once set the pickup volume would not normally need to be varied.

Paging announcements are normally made by the telephone switch operator and the ideal arrangement is a desk-type microphone and a key on the switchboard which breaks the music and allows the operator to make a call. The microphone volume is also pre-set.

MODIFIED CIRCUIT

To meet these general requirements the original circuit was modified as shown, the mixing circuit giving place to a relay-operated switch which connects the second grid to either one of the volume controls.

In at the "at rest" position the relay connects the grid to the pick-up volume control, while in the activated position it connects to the microphone channel.

The supply for the relay solenoid was provided in the amplifier, although in some cases it could be picked up from the telephone circuit or from a special battery.

We obtained an ordinary 50-volt 50-milliamp telephone rectifier (ex-disposals), which was connected across one of the 6.3-volt heater windings. The DC output proved sufficient to operate a small relay with the two 200-ohm windings on the bobbin connected in parallel.

By installing two terminals on the chassis, as indicated, it is merely necessary to close the circuit by means of a remote key switch to cut in the microphone.

MICROPHONE

The microphone selected was a medium-priced dynamic unit which was purchased complete with an in-built mic-to-grid transformer.

It was established that the "voice coil" impedance was in the vicinity of 50 ohms and we accordingly removed the transformer from the microphone with the idea of extending these leads rather than those on the grid side. At 50 ohms impedance there would be no likelihood of loss and no need to shield the leads over the 30-odd feet of extension necessary to the telephone switch position.

The microphone transformer was mounted in a small fabricated metal box and attached to the amplifier input by a cable about three feet long. This was done to avoid hum-pickup from fields around the power transformer and choke. The grid circuit, incidentally, was loaded with a .05 meg. resistor, as specified by the manufacturers.

The choice of record-changer had to be governed, to a large extent, by availability, but we managed to obtain one fitted with a fairly light-weight, high-compliance head. While this augured well for the records it set the familiar problem of low output and uncompensated bass response.

STANDARD -FERGUSON- RANGE

POWER & VIBRATOR TRANSFORMERS

	A.C.	Vib.			Retail
PF 122	240	6	220	40	6.3V @ 2A	56/-
PF 125	240	6	250	60	6.3V @ 2A	65/4
PF 119	240	6	325	125	6.3V @ 4A	93/2
PF 182	240	12	200	40	12.6V CT @ 1A	55/10
PF 126	240	12	250	60	12.6V CT @ 1A	65/4
PF 146	200,30,40	12	325	150	12.6V CT @ 2.5A	109/8

FILTER CHOKES

	Induct	D.C. Res.	M.A.		Retail
CF 100	50	1900	10		30/7
CF 101	30	870	25		30/-
CF 102	15	300	60		20/10
CF 103	30	420	60		43/9
CF 104	30	580	75		46/6
CF 105	15	250	80		39/1
CF 106	12	200	100		39/8
CF 107	30	360	100		58/8
CF 108	12	135	150		56/-
CF 109	20	225	150		58/4
CF 110	12	100	200		67/10
CF 111	16	165	200		67/10
CF 112	10	70	250		67/10

SPECIAL CHOKES

					Retail
CF 113	.5	70	250		
	20		50	Swinging choke	74/6
CF 114	1.1	23	375	Ballast choke	46/8
CF 115	.017	.6	2 amps	L.T. choke	20/5

OUTPUT TRANSFORMER TO VOICE COIL
Full Frequency Range (30-15000)

Code No.	Pri.	Imped.	Sec.	Imped.	Watts	Retail
OP24	5000	SE	8.4, 2.1, with feed back		5	69/10
OP23	3250	SE	12.5, 8.4, 2.1		10	102/-
OP19A	5000	PP	12.5, 8, 2.3		15	148/7
OP31	4500	PP	15.5, 12.5, 8.6, 2.7, 2		20	139/3
OP83	10000	PP	15, 3.75		15	158/6
OP84	10000	PP	12.5, 3.125		15	158/6
OP85	10000	PP	8.4, 2.1		15	158/6

OUPUT TRANSFORMER TO VOICE COIL
Special Full Frequency (20-30,000)

					Retail
OP25/40	10000	PP	40, 10	15	8/6/8
OP25/16	10000	PP	16, 4	15	8/6/8
OP25/15	10000	PP	15, 3.75	15	8/6/8
OP25/12	10000	PP	12, 3	15	8/6/8
OP25/10	10000	PP	10, 2.5	15	8/6/8
OP25/8.4	10000	PP	8.4, 2.1	15	8/6/8
OP66	5000	PP	8.4, 3.7	15	199/6
OP67	5000	PP	15, 6.5	15	199/6

OUTPUT TRANSFORMER TO LINE—
Full Freq. Range.

					Retail
OP22	3250	SE	500, 125, 8.3	10	102/-
OP19b	5000	PP	500, 250, 125	15	148/7
OP21	8000	PP	500, 250, 125	15	121/4
OP62	10000	PP	500, 125	15	158/6

OUTPUT TRANSFORMER TO LINE—
Special Full Freq. Range

					Retail
OP25/500	10000	PP	500, 125	15	8/6/8
OP25/250	10000	PP	250, 62.5	15	8/6/8

VIBRATOR TRANSFORMERS

Code No.	Prt. V.	D.C. Out.	MA	Buffer Full Sec.		Retail
VT 100	32	200	40	.005	Sync.	46/1
VT 101	6	90	15	.008	"	36/2
VT 102	6	150	25	.005	"	32/9
VT 103	6	200	50	.005	"	35/6
VT 104	6	250	60	.005	"	42/-
VT 105	12	250	60	.005	"	45/6
VT 106	6	300	75	.008	"	74/10
VT 107	6	250	60	.005	Sync. Low Rad.	46/6
VT 108	12	90	15	.008	Sync.	37/6
VT 109	24	90	15	.008	"	39/8
VT 110	12	150	25	.005	"	32/9
VT 111	24	150	25	.005	"	42/7
VT 112	12	200	50	.005	"	44/6
VT 113	24	200	50	.005	"	45/6
VT 114	12	300	75	.008	"	81/1
VT 115	24	300	75	.008	"	82/1
VT 116	24	250	60	.005	"	46/6
VT 117	12	250	60	.005	Non Sync. Low Rad.	45/6
VT 119	32	150	25	.005	Sync.	42/-
VT 121	6	180	30	.005	"	44/4
VT 122	6	400	50	.005	"	76/5
VT 123	12	320	125	.005	Sync.	98/-
VT 124	32	250	60	.005	"	49/-
VT 127	6	200	50	.005	Sync. Low Rad.	46/6
VT 128	12	250	60	.005	Sync. Low Rad.	54/1

RECEIVER POWER TRANSFORMERS

Code No.	Prim.	HTV Aside	M.A.	Filaments	Retail
PF 185	240	150	30	6.3V @ 2A	45/8
PF 106	240	325	45	6.3V @ 2A, 5V @ 2A	49/-
PF 198	240	285	50	6.3V @ 2A, 5V @ 2A	45/6
PF 151	200,30,40	285	60	6.3V @ 2A, 5V @ 2A	54/1
PF 165	200,30,40	385	60	6.3V @ 2A, 5V @ 2A	60/6
PF 170	200,30,40	285	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	64/9
PF 168	200,30,40	385	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	63/-
PF 130	200,30,40	285	100	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	70/-
PF 160	200,20,40	385	100	6.3CT @ 2.5A, 6.3V @ 2A, 5V @ 2A	79/4
PF 132	200,30,40	285	125	6.3CT @ 3A, 6.3V @ 2A, 5V @ 2A	88/8
PF 181	200,30,40	385	125	6.3CT @ 3A, 6.3V @ 3A, 5V @ 2A	99/2
PF 174	200,30,40	285	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	93/2
PF 175	200,30,40	385	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 3A	116/1
PF 173	200,30,40	425	175	6.3CT @ 3A, 6.3V @ 2A, 5V @ 3A	129/8
PF 140	200,30,40	385	200	6.3CT @ 3A, 6.3V @ 3A, 5V @ 3A	168/-
PF 171	200,30,40	385	250	6.3CT @ 4A, 6.3 @ 3A. 5V @ 3A	11/1/8
PF 201	240	225	50	6.3 @ 2A	46/6

LINE TO VOICE COIL TRANSFORMERS

	Pri.	Imped.	Sec.	Imped.	Watts	Retail
MT111	500		12.5, 8, 2.3		10	62/10
MT100	600		4, 3		15	58/4
MT101	500		15		15	58/4
MT124	600,	500	4, 3, 2.7, 2.3, 2		25	98/-
MT125	600,	500	15, 12.5, 8.4, 6.5		25	95/8

MODULATION TRANSFORMERS

				Retail
MT118	8000, 6000 PP	10000, 7000 5000	25	154/-
MT119	8000, 6600, 3800 PP	10000, 7500, 6500 5500, 4500, 3500	50	177/4
MT120	500 to 20000 in steps.	500 to 30000 in steps.	50	324/4
MT121	500 to 20000 in steps.	500 to 30000 in steps.	125	320/10/8

Output Transformer To Voice Coil—P.A. Range

	Pri.	Imped.	Sec.	Imped.	Watts	Retail
OP1	5000, 2500 SE		12.5, 8, 2.3		10	61/8
OP54	5000, 2500 SE		15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2		10	74/8
OP39	5000, 2500 SE		15		10	65/11
OP33	5000, 2500 SE		5, 2.7		10	65/11
OP41	5500	SE	3.7		10	73/8
OP53	30000, 20000 14000, 10000, 7000 5000, 2500 PP		2.2		10	63/8
OP2	5000	PP	12.5, 8, 2.3		15	99/11
OP55	5000	PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2		15	99/11 109/6
OP3	6600	PP	12.5, 8, 2.3		15	99/11
OP56	6600	PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2		15	99/11 109/6
OP4	10000	PP	12.5, 8, 2.3		15	99/11
OP57	10000	PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2		15	109/6
OP5	10000, 6600, 5000	PP	12.5, 8, 2.3		15	99/11
OP58	10000, 6600, 5000	PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2		15	110/10
OP59	10000, 6600, 5000	PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2		25	138/10
OP60	10000, 6600, 5000	PP	15, 12.5, 8.4, 6.5, 4, 2, 2.7, 2.3, 2		32	177/2

OUTPUT TRANSFORMER TO LINE—P.A. Range

	Pri.	Imped.	Sec.	Imped.	Watts	Retail
OP1A	5000, 2500 SE		500		10	61/8
OP44	5000, 2500 PP		500, 250, 125		10	77/-
OP34	5000 PP		600, 300, 200, 150, 130, 100 75, 50		15	119/-
OP6	5000 PP		500, 250, 125		15	99/11
OP7	6600 PP		500, 250, 125		15	99/11
OP50	8000 PP		600, 300, 120, 60, 30		15	207/8
OP8	10000 PP		500, 250, 125		15	99/11
OP8M	10000 PP		500, 250, 160, 125, 100, 83.5 71.5, 62.5, 55.5, 50		15	8/7/10
OP9	10000, 6600, 5000	PP	500, 250, 125		15	99/11
OP10	5000 PP		500, 250, 125		25	120/7
OP11	6600 PP		500, 250, 125		25	120/7
OP38	6600 PP		600, 300, 250, 200, 170, 150, 76, 50, 36, 27, 12.5, 7.5, 3.6, 2.7		25	207/8
OP12	10000 PP		500, 250, 125		25	120/7
OP13	10000, 6600, 5000	PP	500, 250, 125		25	120/7
OP35	10000, 6600	PP	500, 4000, 3.4, 2.2		25	170/4
OP14	5000 PP		500, 250, 125.		32	146/1
OP48	6600 PP		140, 70.		32	177/4
OP15	6600 PP		500, 250, 125		32	146/1
OP15M	6600 PP		500, 250, 166, 125, 100 83.5, 71.5, 62.5, 55.5, 50		32	7/7/8
OP16	10000 PP		500, 250, 125		32	146/1
OP17	10000, 6600, 5000	PP	500, 250, 125		32	146/1
OP36	3800 PP		17.6		60	7/15/5
OP18	3800 PP		500, 250, 125		60	157/6
OP61	3800 PP		100, 75, 50, 25, 10, 5, 2		60	262/10
OP37	6400 PP		500, 250, 125		80	214/8
OP49	8800, 6000	PP	500		105	323/6
OP20	11600. 8400	PP	500, 250, 166, 125		150	20/10/-

ALL PRICES SUBJECT TO ALTERATION WITHOUT NOTICE

Fortunately, the deletion of the ixing circuit boosted the pickup hannel gain by some 6db so that ie pickup was just able to load the mplifier fully with the gain at naximum.

To improve the tonal balance a eries condenser was installed in the eedback network, and the pickup hannel was loaded also with a .05 meg. resistor. These modifications would not be necessary, of course, or a crystal pickup.

The whole outfit was housed in a abinet, as illustrated, which meas- res approximately 40in high by 36in ide by 18in deep, the finish matching he rest of the office furniture. A ft-up lid and locking doors give ccess to the amplifier and the record- hanger, which sit side by side on a helf.

The whole of the space beneath the helf is occupied by compartments or record storage.

/ENTILATION

In the back of the cabinet is a eries of vertical slots so placed that hey allow free movement of air from nderneath the shelf, up past the ront and over the top of the ampli- er, even with the door and lids losed. As a pageing system, the am- lifier may be on all day and ventila- ion is an important consideration.

All connections were run out hrough the rear of the cabinet and hese included a multi-cored cable xtending the transformer secondary appings to a telephone terminal lock on the wall, which gives easy ccess to the five speaker lines. These ines, by the way, were run in ordin- ry twin tough-rubber, following tandard electrical practice. Each peaker output was a 2-pin round ocket at the ceiling height, corres- onding plugs being fitted to the peakers.

One side of each line was bridged o the "common" lug on the output ransformer, the other sides connect- ing as required to the individual out- put tappings.

Connection to the various speaker ines provided food for careful thought and it is better to grasp the principles rather than the details of the par- ticular installation.

Irrespective of individual connec- tions and lines, the plain fact of the matter was that twenty-odd speakers would need to be operated from the amplifier, all substantially connected in parallel. There are various reasons why a series connection is not worthy of consideration.

MODELLING

Now, twenty speakers in parallel, each fitted with a 10,000 ohm input transformer, would give a net im- pedance of 500 ohms, equal to the highest output impedance available from the amplifier.

Better still, we reckoned that the same speakers, fitted with standard 5000 ohm transformers, would end up at 250 ohms, which was a more con- venient value. If some lines had to be connected across fewer turns to re- duce the relative volume, the loading could be preserved with this latter arrangement by running other lines across more turns to increase volume.

Finally, to simplify ordering, we specified 5000 ohm transformers for the 12-inch speakers and 7000 ohm transformers on the 7-inch speakers, on the assumption that the larger ones would, in the main, be operating at higher volume. A little thought will show that, as the nominal transformer impedance is reduced toward the source impedance, the output from the particular speaker must increase.

Examining the situation, the three speakers in the main hall would ob- viously need to operate at the highest volume, the net impedance being 5000/3 equals 1660 ohms. In other words, these three speakers, connected across the full 5000 ohm secondary, would present a little less than one- third of the total required loading.

Under the mezzanine floor were six speakers, each with a 7000 transfor- mer and therefore representing a total load of 1100 ohms in round figures. The duplicate line above the mezza- nine, carrying also the extra 12-inch speaker, worked out to 900 ohms. Assuming that these lines were con- nected to the 250 ohm tapping for medium volume, they would each im- pose on the amplifier about one- quarter loading.

IMPEDANCES

The three speakers in the long nar- row room, requiring only very low volume, would most likely run across the 100 ohm tap. Thus 1660 ohms across 100 ohms represented one- sixteenth loading.

Finally, the two speakers on the separate end rooms, representing a net 2500 ohms, might run to the 250 ohm tapping, representing one-tenth loading.

Add all these fractions together and you get something very close to unity and substantially correct loading.

For those who like the long way around, all these impedance figures could be referred to the primary like this:

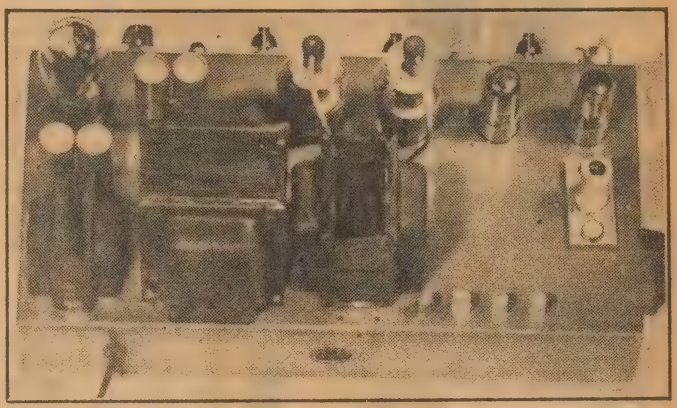
Assuming a 10,000 ohm primary, the 500 ohm secondary represents an im- pedance ratio of 20 : 1. Therefore, 1660 ohms across 500 ohms becomes 32,200 ohms. Next in order, 1100 ohms across the 250 ohm tapping becomes 1100 x 40, equals 44,000 ohms. The other lines in order add 36,000 ohms, 166,000 ohms and 100,000 ohms. Add these parallel resistance values to- gether and the result is very close to 10,000 ohms.

When finally tested out, very little modification was necessary to these conditions, as set up and, with the amplifier operating at only a fraction of its total power, there was a com- plete low-level blanket of sound throughout the whole factory.

TESTING

On a speech check using the micro- phone, a male reader and a handy ex- tract from one of our technical articles, it was possible to walk throughout the entire factory without missing a single word. More could not be expected of any system.

By way of conclusion, a few brief remarks may be helpful regarding the choice of suitable music.



A general view of the amplifier, showing power supply and output at the left—input stages at the right.

A great deal of research has gone into the subject and findings have been published from time to time in semi-technical journals, employers and manufacturers' journals, and such like. Resource to a public library or to a chamber of manufactures will often bring the information to light.

While the choice of program must be governed to some extent by the type of work and the class of em- ployee, the safe rule is to favor mel- odic music in the simple sense of the term. "High-brow" programs have very restricted appeal, while noisy jazz and "effects" numbers disturb some listeners and drive others to distraction.

Slow waltzes may affect the tempo of work, while the tendency of vocal hits to produce an impromptu sing- song must also be considered. Num- bers should be avoided which induce employees to down tools in order to clap hands, &c., in time with the rhythm.

Despite the rather formidable list of "don'ts" there is not likely to be any great difficulty in building a varied program from pop. numbers, musical comedy and a sprinkling of the better known tunes from the clas- sics.

If the effect of the sessions is carefully studied in the initial stages and due note taken of the preferences and objections of employees, a suit- able library of records will ultimately be built up.

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PHONEVISION SUCCEEDS IN USA

WILL PHONE-GADGETED TV SPREAD?

Phonevision uses a normal TV station which however does not transmit the synchronising pulses needed to keep each separate frame or picture in step. These pulses are sent over a telephone line after a subscriber has dialled for them and is charged a fee for the service. Fed into his TV set they allow him to see a film broadcast. Our correspondent Harold Heffernan tells of its initial test recently carried out.

PHONEVISION'S crucial 90-day test among 300 Chicago families is now past its half-way mark. What are the results to date? Is the phone-gadgeted TV to be the thing of the future?

No one can guess the answer, but Hollywood is intensely interested in the final summation of the trial runs. Most of all, 18,000 theatres of the nation are vitally concerned. For, should phonevision reach the fantastic heights predicted for it by Eugene F. McDonald, president of the sponsoring Zenith corporation, a revolutionary upheaval in exhibition properties would result.

TEST FIGURES

Even though his first report may be a little statistical and technical, we're printing herewith portions of a letter directed by McDonald to Nicholas Schenck, chairman of the board of the Motion Picture Producers' Association, which furnished the features (of their own designation) for the phonevision test:

"Enclosed is a significant summary of the pictures that have had showings in the first four weeks of the phonevision test—what each one of them took in per showing as ordered by the 300 participants, and what these features had formerly grossed. Also enclosed is an equally significant summary of what our participants have told us about each of the pictures they have seen . . . .

"There are only 300 participating families that could have ordered these pictures. These were selected by the National Opinion Research Centre of the University of Chicago . . . they represent a cross-section of Chicago—from the Gold Coast to basement apartments. . . .

"The ten lowest pictures in these four weeks grossed an average of 66.10 dollars out of a maximum possible of 300 dollars. This is 22 per cent of our possible audience—relatively few feature pictures produced in the last 20 years have played to that large a percentage of the possible theatre audience on their first showing.

HIGH PERCENTAGE

"Our over-all average has been 30 per cent of our possible audience, a figure that staggers the imagination when projected among the television families of the nation.

"How can we account for these phenomenal grosses? Novelty? Sure, let's discount the figures heavily for that. In order to make these figures realistic, let's omit in our calculations the fantastically high returns yielded by **Welcome Stranger** and **Homecoming** on New Year's Day, and also the balance of the entire first week of our operation. Our average return after omitting the first week's operation is 26 per cent of our total possible audience.

"I feel it necessary to point out that at the beginning of the test many of our 'customers' were making a gala event of phonevision; they were inviting their neighbors, throwing phonevision parties. As time passes, as their bills pile up, and as they realise their entertainment cost for food and liquor, their patronage will probably decline. So will the average number of people in each home that views the pictures. We can't possibly maintain the returns shown by the first three pictures on New Year's Day, which grossed 398 dollars, or an average of 133 dollars per picture.

"But novelty plans only a part, and probably a small one at that, in explaining these phenomenal results. If you examine the summary of post-card reports from our 'customers' you will see that, except for a few great classics, four out of five are seeing the pictures they purchase FOR THE FIRST TIME, in spite of the fact that each of these pictures has long since completed its theatre run, and that some have been re-issued. You will also note that nine out of ten say they prefer seeing their pictures at home.

NEW AUDIENCE

"It is self-evident that with phonevision we are reaching that vast segment of our population that never were regular theatregoers, and that in reaching this new audience we are adding countless millions of dollars to the value of the old features you have in your vaults. It is not beyond the realm of possibility that many of your older pictures will earn more for you on reissue by phonevision than they have earned to date in theatre showings. . . .

"These first results are fabulous. And you must remember that this test is handicapped by the age of the pictures. ALL played in theatres before the majority of our test families owned receivers, most during the high water period of theatre attendance. We have secured phenomenal results by tapping an audience that did not see these pictures in the theatre. I think it is reasonable to assume that many of those who did not buy the pictures on phonevision refrained because they had already seen them. Can you imagine, then, how much more startling our results would be if we were presenting new pictures that NONE of our families have previously seen?

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- Cabinet and Chassis drilled and finished in black crackle, illustrated below.
- Bakelite socket for 5BP1 Tube.

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150 Kc/s	500 Kc/s	5.5 Mc/s	20 Mc/s
500 Kc/s	1.5 Mc/s	20 Mc/s	80 Mc/s

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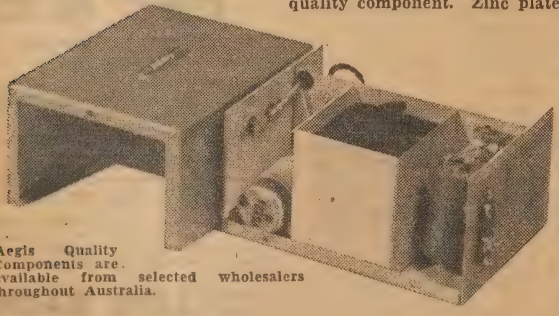

Aegis Quality Components are available from selected wholesalers throughout Australia.

SPECIFICATIONS:

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"You will note from the attached summary that disregarding the first week, we have maintained an average attendance of 1.8 times per week per family. Projecting this against the 10,000,000 television receivers presently in use, would indicate a producers' income of 468,000 dollars annually."

McDonald concludes his report with an urgent suggestion that Schenck, together with all other top studios in Hollywood, send capable emissaries to Chicago for the purpose of checking audience reaction—this as a means of convincing the tycoons that his opening estimation is authentic. Whether they will comply is highly problematical. To one another they confide the hope that McDonald and his old phone-vision will go forget itself after the 90-day run.

But will it? All Hollywood hangs on the answer.

MOVIES NOT DONE

Another interesting angle is provided by a further report from Heffernan.

There's good news today, good news that is for some 21,516 harassed motion-picture theatre operators throughout the country (including 2205 drive-ins) practically all of whom have been figuring that maybe television had them in a death-grip after all.

Up today with the heart-warming word that it "ain't so at all" comes E. J. Hudson, one of the most important chain movie-house managers in the country. Hudson has just announced results of a survey concerning the habits of television viewers, mainly as they affect attendance at his theatres.

"1. Before acquiring a television set each person interviewed had patronised a motion-picture theatre on the average of once a week.

"2. Those who had owned sets for three months or less had not patronised any motion-picture theatre since acquiring the set.

"3. Those who had owned sets for three months, and not more than six months, had patronised a theatre a couple of times to see attractions they thought were outstanding.

"4. Those who had owned sets for six months, but not more than nine, had resumed their theatre patronage on an average of once every three weeks.

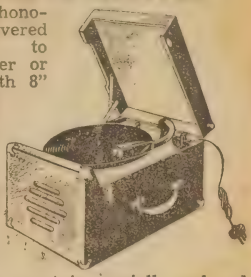
"5. Those who had owned sets for at least nine months, but not more than one year, were again patronising motion-picture theatres on the average of once every two weeks.

"6. There were a total of 85 individuals out of the 411 questioned who had owned sets for ONE YEAR OR MORE. Each of these persons stated that he or she and members of their families now were interested in only three or four particular television programs each week and that they were patronising motion-picture theatres on the average of once a week, for a so-called 'night out.'"

Hudson points out that all of those owning sets for six months or more were critical, in varying degrees, of the average quality of television programs.

PORTABLE ELECTRIC PHONOGRAPH
240 VOLT A.C. MAINS OPERATED

This self-contained portable electric phonograph is housed in a leatherette covered carrying case and is complete ready to operate from any 240 volt A/C power or light socket. It has an amplifier with 8" speaker and electric phonograph motor and crystal pickup built into the cabinet. It is equipped with a volume control and on-off switch.



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Freight and packing £1 extra. Country Orders accepted. C.O.D. N.S.W. only. Cash with order Interstate.

Limited number available, as this instrument is specially reduced from £21/10/-. Place your order now and avoid disappointment.

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Insulated Pliers

5000 volt handles with wire cutters 6½"

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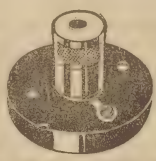
Weatherproof Lantern

Exterior torch weatherproof lantern with flame shape glass shade.

£2/5/-

£2/10/- packed and posted.

NEW INVENTION CRYSTAL DETECTOR



The "Red Spot" highly sensitive, semi-fixed permanent crystal detector is now available from Radio House Pty. Ltd. for 9/6, 10/- posted. The "Red Spot" will take the place of the old type crystal and cat-whisker and give much better and more constant results. When necessary, it is easily adjusted by means of the knurled cap as illustrated.

POCKET KNIFE

This imitation bone handled pocket knife has a 3" high quality steel blade, screwdriver, can opener, bottle opener, corkscrew and splicer.

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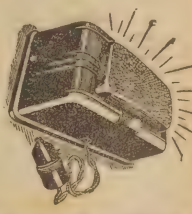
Specially Imported Super Torch

Turning head torch No. 4733 chrome plated brass case with adjustable swivel head. Incorporates safety switch, belt clip, adjustable focus, spare globe holder, complete with batteries and globe. Each posted 19/6

Spare globes, 7d each.

BED LAMP

Battery operated bed lamp in attractive coloured plastic cases, green, white, blue and pink. Sizes 5" x 3" x 2½". Attaches to the head of bed, complete with self-contained battery and pendant switch. Spare battery standard cycle type No. 701, 2/6 each.



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Here's your answer, Tom!

We are well aware that Tom is a wide awake individual, keen to learn about everything from crystal sets to television transmitters. His efforts this month are no exception for the questions even bring technical journalism into the arena.

FOR example, take his first query.

A recent issue of Radio and Hobbies carries an advertisement for various types of transformers. Among the types advertised are "output transformer to line," "output transformer to voice coil," and "line to voice coil transformer." Could you offer some enlightenment, as I find this very confusing?

We don't want to become involved in an argument on syntax, Tom, but the descriptions may be clearer if we were to make them read "output transformer (to line)" and "output transformer (to voice coil)" respectively.

Speaker voice coils usually have an impedance of between 1 ohm and

15 ohms, so that the devices labelled "output transformer to voice coil" are intended to couple the output valve (or valves), which require an impedance of between 2500 ohms and 30,000 ohms, to the low impedance of the voice coil. In the ordinary receiver the matter ends there.

However, it is sometimes necessary to operate speakers at some distance from an amplifier. The problem then arises as to how to couple them together.

If the output transformer is located at the speaker, the long plate and B-plus leads present insulation and safety problems. There is also the possibility of oscillation when the plate leads of the output valves are extended.

Alternatively, if the transformer is located on the amplifier or radio, there may be a loss of power due to the DC resistance of the line. This can easily amount to several ohms where a long speaker run is involved.

The solution to the problem is to use an intermediate or "line" impedance for the long run, and mount transformers both on the speaker and the amplifier. A popular figure for the line impedance is 500 ohms, but anything from 100 to 1000 ohms is frequently used. The idea is that the line impedance be high enough to make the resistive losses negligible and at the same time low enough to prevent loss of the treble end due to line capacitance.

Where it is desired to feed two 500 ohm lines from an amplifier, the output transformer would be tapped at 250 ohms and the lines connected in parallel. For four lines a 125 ohm tapping would be required, &c.

My nearest broadcast station is 200 miles away. Would a catswhisker reach that far?

We wouldn't like to say, Tom, but it would need to be some cat!

The range of a crystal set is usually limited to about 15 miles. Under exceptional circumstances a greater range than this is possible, but we don't think that your chances are very good. The most elaborate crystal set still depends on the energy received from the aerial to operate the headphones, and you can imagine that this energy is very small after it has been distributed over a radius of even 15 miles.

How does a crystal detector separate the radio frequency carrier and the audio frequency modulation?

We can best answer that question, Tom, by going back a step and explaining why it is necessary to detect in the first place.

The carrier wave operates at much too high a frequency to effect the ear or, for that matter, to operate the diaphragm of a phone or the cone of a loudspeaker. Before the diaphragm has time to move in one direction the current is trying to make it move in the opposite direction. The net result is that it simply remains stationary if only a radio-frequency carrier wave is applied directly to the phones.

The detector is simply a rectifier. It only allows the current to pass in one direction so that the high-frequency pulses add together and produce a definite movement of the diaphragm which follows the average strength of the pulses—in other words, the modulation, which is at an audible frequency.

You mention in a recent article that it may sometimes be desirable to wire a condenser between the plate of the output valve and earth. Does this extra earth wire need to be insulated away from the wire connecting the chassis and earth?

No, Tom. As a matter of fact, it need not even exist.

And that hasn't got anything to do with the story about making a radio into a "wireless."

You see, when we speak of "earth" as in the aforementioned article, we generally mean the chassis of the set. The latter is often connected to earth by a single wire, but even this is not always essential, as you can easily prove, particularly with an AC operated job.

In a typical five-valve set there are dozens of connections made to the chassis which serves as a neutral or reference point.

Imagine the trouble if you had to run two or three dozen separate insulated wires from the set out to a hole in the garden.

The electricity supply at my home is very unreliable. Can I make a radio to work from the gas mains?

Yes, Tom, but unfortunately we can't supply a circuit and wiring

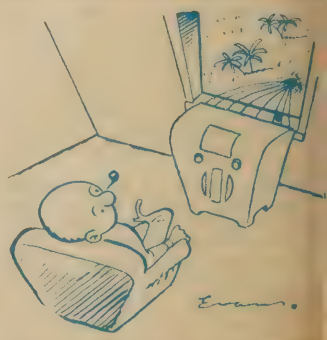

diagram through the query service.

The principle on which a gas-operated radio depends is really quite simple.

If the junction of two dissimilar metals is heated, a potential difference will appear between them. The electrical energy obtained in this way can be used in an external circuit. The device is known as a thermo-couple and is best known to readers

or its use in radio frequency ameters.

A great many thermo-couple units re required to operate a radio. They re series and/or parallel connected o supply the correct voltages for the ilaments and high tension on sets which must use economical valves, ince the system is very inefficient nd the total amount of power obainable very small.

We believe that gas-operated radios vere made in England on a commercial basis before the war. At hat time the extensive electricity upply network had not been comleted in many districts, particularly round the coalfields, while gas was n plentiful supply.

We know just how you feel, Tom, having experienced blackouts halfway through the morning shave, but n the absence of commercially-made hermo-couple units the most satisactory solution would be to obtain radio which operates from batteries. Either that or make up a unit like the one described last month.

Precisely what is the difference between a modulated oscillator and a signal generator?

About £50, Tom, to be concise if not precise.

Generally the term "signal generator" refers to a better class of nstrument, while a "modulated oscilator" describes the less pretentious of the same species. However, there s no clear division between the two, and many overseas manufacturers give the name signal generator to nstruments which are quite cheap and quite nasty.

In the case of a signal generator, we would expect to find reasonably accurate frequency calibration and, even more important, an accurate means of measuring the voltage output of the instrument at all levels. When measuring the performance of highly sensitive modern receivers, the "leakage" (output with the attenuator in the off position) must be very low.

Most signal generators make provision for modulation either of fixed or variable frequency and also provide a means of adjusting the modulation to known depths. If no means of varying the frequency of the modulating voltage is available, it is usual to make provision for feeding the output of an external audio source into the generator, in which case square waves and other special tests can often be applied.

An oscillator, on the other hand, consists simply of a radio frequency oscillator valve which may cover, say, between 500kc and 30mc with a dial giving the approximate frequency and some simple form of attenuator, the latter usually without any serious attempt at calibration.

An audio frequency oscillator is usually provided for modulating purposes, but its frequency is fixed and there is no continuously variable modulation depth available. With an oscillator it is usual for there to be a certain amount of frequency modulation at the same time as amplitude modulation but for its usual application, this is not of any great importance.

In general, an oscillator is quite satisfactory for adjusting domestic receivers, but a signal generator is required for making performance measurements and adjusting more elaborate equipment such as communication receivers, &c.

My radio operates from batteries and uses the 2-volt series 1C7-G, 1M5-G, &c. However, we have recently been connected with the power mains and I would like to dispense with the batteries altogether if possible. Can you supply a suitable circuit?

It would be possible, Tom, but with the current rates for haulage contractors and builder's laborers, a bit on the expensive side.

You won't be able to carry the equipment in the family car, and the little lady isn't likely to sanction the idea of a choke the size of the piano in the living-room — not to mention the filter condensers.

You see, Tom, it is extremely difficult to make a satisfactory filament power supply for this type of set, and the idea is not worth pursuing.

No matter how much filtering is provided for a parallel string of these directly heated valves, there always seems to be a certain amount of residual hum. Even with an accumulator across the line to act as a reservoir, the hum still seems to get through.

The high-tension supply is no great problem and can follow along the lines of a power supply for a conventional a-c operated set. Your best idea may be to retain the accumulator for the filament and charge it when the set is not in use. A simple charger is not hard to make.

Alternatively, you may find it more satisfactory to replace the present valves with indirectly heated types and operate the filaments from AC as in a conventional mains operated receiver.

AN electric blanket was used to keep a sun observing instrument warm during flight in a B-29 high altitude flying laboratory. Dr. Ronald Anthony of the US Naval ordinance test station, Inyokern, California, reported to the American Physical Society in Los Angeles that the electric blanket kept the temperature of the instrument constant within two degrees Fahrenheit.

The instrument, a monochromator, focuses the sun's rays so that they can be observed at one wavelength only. The infra red region was studied during this flight.

LIKE an alarm watch that rings a warning, The Atomic Energy Commission has announced the invention of a pocket radiation alarm. Designed to sound an alarm when exposure to radioactivity or other harmful radiation accumulates to too high an amount, the new device was patented by R. J. S. Brown of Laundale, California, and H. G. Weiss of Waltham, Mass. It can be set for the desired amount and carried anywhere on the person.

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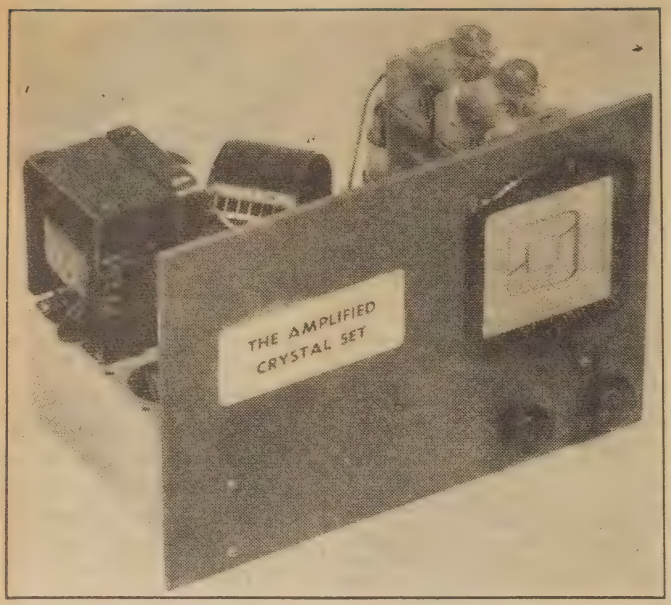


This picture shows the chassis with additions. The valve can be seen just behind the tuning condenser.

LEARN WHILE YOU BUILD

This month you are to take a big step forward. No longer are your results to be limited by the signal strength in your aerial. Permit us to introduce the valve, a very important device about which you are going to learn a lot in the coming months. For the present however, we will tell you something of how it works, and how to make a small amplifier for your crystal set.

UNTIL now the performance of your set has been strictly limited by the strength of the incoming signals. Given reasonably strong signals, you get good performance but, where the signals are weak, the performance is poor and there is very little you can do about it.

Very little, that is, unless we can amplify these hard-to-hear signals. To do this we will need a number of new components. The most important one is the valve, for it is within this rather amazing device that the amplification actually takes place.

VALVE OPERATION

And how does the valve amplify? It's not so hard to understand really. Take a look at figure 1a where we see the symbol for one of the simplest forms of valve — the diode (meaning two electrodes). In this symbol the circle stands for the glass envelope, the semi-circular electrode at the bottom is the "filament," and the horizontal line at the top represents the "plate."

The filament is similar to that in a light globe, although it varies somewhat in detail, while the plate may in fact be a flat metal plate or a metal cylinder surrounding the filament. The interior of the envelope is exhausted to a high degree of vacuum.

Now take a look at figure 1b where a battery is connected across the filament, which is thus raised to operating temperature. Incidentally, this also introduces a new symbol, that for a battery.

The heating of the filament brings us to what is really the crux of the whole matter — electron emission. This simply means that the hot filament emits electrons, or tiny particles of negative electricity which, in the absence of any other force, collect in a cloud around the filament.

Figure 1c shows us what happens when we do apply some other force. Here the plate has been connected to the positive terminal of a battery the negative side of which connects to the negative side of the filament. This means that the plate is positive with respect to the filament and the electrons (negative) will be attracted to it. (Like charges repel, unlike charges attract.)

The higher the voltage applied to the plate the more electrons will be attracted until a point is reached where all the electrons leaving the filament will reach the plate (saturation).

The movement of electrons across this open space makes possible an electron movement through the external circuit (as shown by the arrows) and a current measuring meter included in the circuit will show a reading. Since the movement of electrons is what constitutes a flow of current we may say that the electron emission makes possible a flow of current through space.

"All very interesting," you may say, "but where does it get us?"

"Don't rush me, but take a look at figure 1d. Notice that the plate bat-

by Philip Watson

tery has been reversed so that the plate is now negative with respect to the filament. Because electrons have a natural negative charge these and the plate now have like charges and like charges repel. Thus the electrons scurry back to the region of the filament and there is no electron movement across space or through the external circuit.

What do we deduce from this?

Simply that it is possible to pass current through space by means of electronic emission, but, and this is the important point, only in one direction.

AMPLIFICATION

This ability of a valve to suppress the flow of current in one direction is extremely valuable, making it possible, among other things, for it to "detect" RF signals in the same way as does a crystal. However, this must not be confused with its ability to amplify, the characteristic which we are seeking at the moment.

In order to understand this function we must carry our examination a step farther, so take a look at figure 2a. It is similar to figure 1c except that we have introduced

nird electrode known as the "grid." This takes the form of a wire mesh, r open spiral, placed between the lament and the plate.

In figure 2b we see one effect of pplying voltages to this new elec-rode which in this case is being ade negative with respect to the lament negative point.

A negative grid will repel electrons n exactly the same way as a nega-ive plate, but, when only a small oltage is applied, the open construc-ion will allow some electrons to pass hrough to the plate. Thus, a nega-ive grid tends to reduce the plate urrent and, if the voltage is made igh enough, all the electrons will e repelled, none will reach the late and we have a condition known s plate current "cut-off."

Now, let us try the effect of re-ersing the connections to the grid, he set-up being shown at 2c. under hese conditions the positive grid will ttract electrons, but since its area is mall it will collect only a few, the emainder being accelerated on their vay to the plate. Thus, there will e a flow of current in the grid circuit nd the plate current will also be ncreased.

Now, so far, it would seem that the grid merely provides a different nethod of controlling the plate cur-ent, but there is a very important difference. Because the grid is ocated closer to the filament than is he plate it will have a greater effect on the electron flow for the same applied voltage.

AN EXAMPLE

To give a simple example. We may find that by varying the plate voltage over a range of 50 volts we change the electron flow by 10 milliamps. But we may produce this same 10 milliamps change by varying the grid voltage by only 5 volts. It follows that the grid has 10 times more effect on the electron flow than has the plate and the valve would be said to have an "amplification factor" of 10.

Starting to catch on?

Good. Now take a look at figure 2d and you will see that we are starting to make practical use of this amplification factors. The meter in the plate circuit has been replaced by a pair of headphones, while the headphone terminals of the crystal set are now connected between the grid and the filament negative of the valve.

Those signals which would have previously been applied to the headphones are now fed to the valve input circuit, where they are used to control the electron flow through the valve and the headphones. Because of the amplification factor the changes in flow through the phones will now be many times greater than if the signals had been applied to them direct. Result? Louder signals!

POWER SOURCE

There is another important point to be noted here, I think.

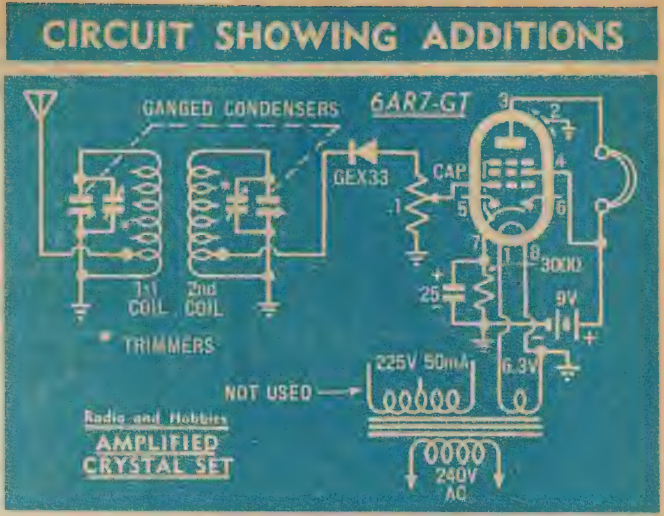
The power which produces the signals in the phones is no longer that which was radiated by the transmitter. Instead it comes from a purely local source—the plate battery. It is the valve which makes it possible for the incoming signal to control this power so accurately that it produces an exact, though amplified, copy of the signal in the headphones.

When a valve is to be used as an amplifier it is important to avoid those extreme operating conditions which have already been mentioned, such as saturation point, plate current cut-off and positive grid with grid current. If any of these conditions are permitted the result will be a failure of the valve to operate efficiently or serious distortion, or probably both.

The condition most likely to occur is that of a positive grid since the incoming signal will be alternating and will consist of both positive and negative pulses. To avoid this we apply what is known as "bias" to the grid of the valve. This means making the grid slightly negative by means of a battery or other local source before any signal is applied. This done the positive signal pulses will not drive the grid positive, but only make them less negative.

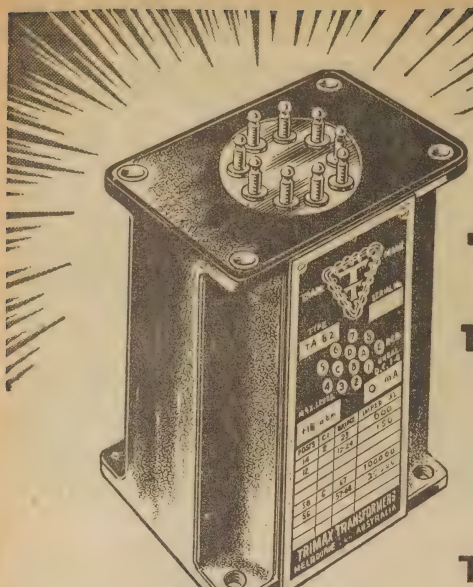
So far we have been considering the battery type valve which is used extensively in country districts and for portable sets. However, where commercial power is available it is far more convenient and economical to use an AC valve.

In this type, the filament is no



The circuit shows how the valve is added to the original crystal circuit.

This rear view clearly shows the power transformer and valve mounting.



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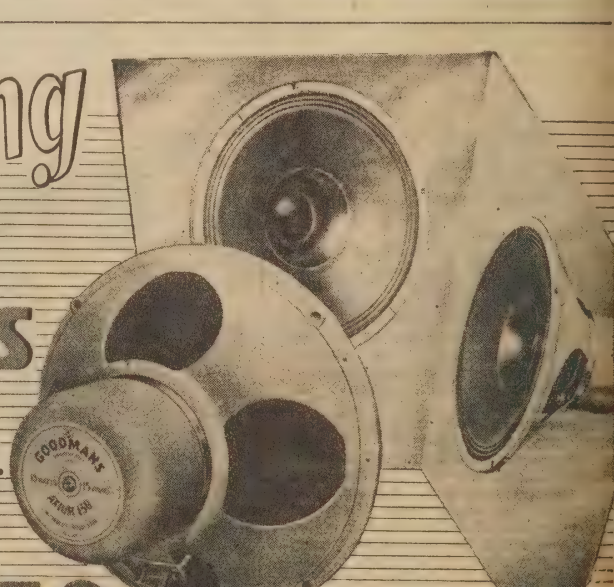

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longer the electron emitting surface, but merely serves to heat a new electrode called the cathode. This now becomes the new electron emitter and is electrically insulated from the filament. Connection to the cathode is made through a separate base pin and this is treated in the same way as the negative filament point in our discussion so far.

Isolation of the cathode avoids the hum which would be introduced by the use of alternating current on a directly-heated battery type valve.

This is probably enough "theory" for one sitting, so we will now consider some of the more practical aspects of our valve. (I hope the Technical Editor doesn't start another argument about this.)

The valve we have chosen is the 6AR7-GT. It is a fairly recent release and, in addition to making a very efficient amplifier for our crystal set, it will also be suitable for the remainder of our circuits. For the moment, there will be some electrodes which are not required, since it is a multi-purpose tube but these will fall into the scheme of things in our final set.

Identification of the base pins is something which seems to cause beginners a lot of bother. We usually indicate the pin numbers on our diagrams, but we would strongly advise that you set about collecting as many valve manufacturers' data sheets and booklets as you can.

VALVE DATA

Some of these contain only a few sheets and list the most popular valve types. Others are quite solid booklets and list nearly every valve that has appeared on the Australian market. In addition to the base connections, there is much other information such as the application, typical operating voltages for the various electrodes, physical size, &c., and they are really a "must" for anyone interested in radio.

To go with the valve you will need a socket, and there are a number of makes on the market. Most of these are quite satisfactory but, before you buy, make sure that the mounting holes will correspond with those on the chassis.

Power to operate the valve must now be considered and, for the filament, we will require 6.3 volts at .3 amp of alternating current. To obtain this from the 240-volt house supply we will need a transformer and as we will eventually use such a device to supply all the power for our set, it is advisable to buy one which has the necessary additional winding. This will need to supply 225 volts each side of a centre tap, with a current capacity of 50 milliamps.

THE BATTERY

For the moment, however, our high-tension supply is to come from a battery, as this makes things much simpler and avoids taking on more than can be managed at one bite. The high-tension is not really very high, being only a 9-volt battery, but it is quite adequate, while the cost is very little. There is not much point in investing in a larger size, since you will soon be past the point where batteries are needed and we wish to avoid waste of components.

Another new component is the "resistor," and in this circuit we find it in two different forms. The zig-zag line which you will see in two places in the circuit diagram is the symbol for this component, but in one case you will notice that there is a slight variation. This is the arrow which comes from one side of the symbol and goes to the grid of the valve. It means that the resistor has an adjustable tapping which may be set at any point between the two ends. The type used in this set is known as a potentiometer, a volume control, or simply a "pot."

Resistors are rated in ohms, or megohms (one-million ohms) when large values are involved. They have, in addition, a wattage rating which indicates how much power they can safely handle before their temperature rise becomes too great. Popular sizes for radio work are half and one watt.

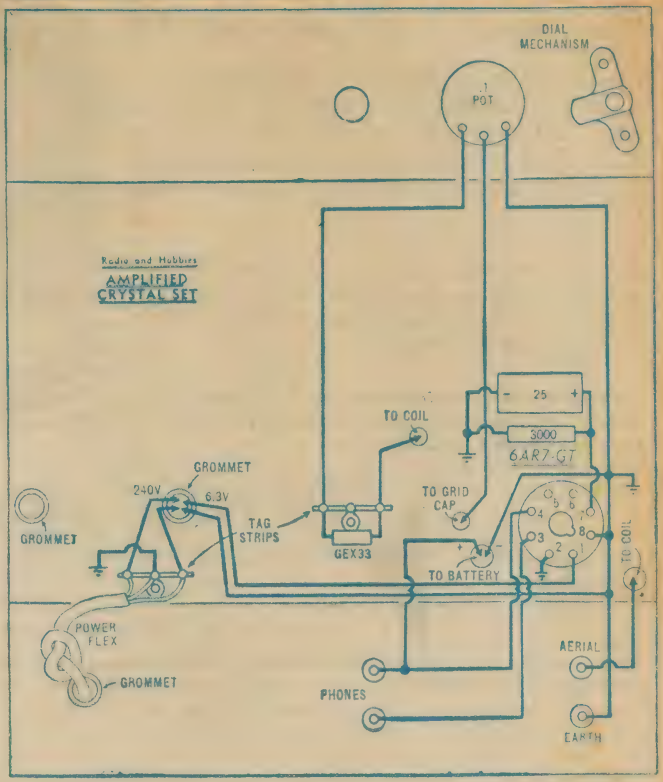
The general placement of new components will be seen from the photographs. The valve is mounted immediately behind the gang, and the transformer in the rear left-hand corner. The potentiometer is mounted on the front of the chassis, where a dummy knob was shown on last month's set.

The circuit and wiring diagram should provide all the information you require to complete the wiring. It should not present any great difficulty, as there is not a great deal of it. However, there are one or two points which call for special mention.

First and most important is the wiring of the power transformer, particularly in regard to the connection to the power flex from the mains.

You probably don't need to be told that the amount of power available

WIRING DIAGRAM OF THE SET



Beginners particularly will find this wiring diagram helpful in building the receiver.

PARTS LIST

- 1 6AR7-GT valve.
- 1 Type PF 201 transformer (or similar).
- 1 9-volt "C" battery.
- 1 3000 ohm resistor ½ or 1 watt.
- 1 .1 megohm potentiometer.
- 1 25 mfd, 40 volt electrolytic condenser.
- 1 Octal socket.
- 1 Grid clip.
- 1 3 tag terminal strip.

Grommets, power flex, hookup wire, solder lugs, spaghetti, nuts and bolts etc.

The Model "8" AVOMETER

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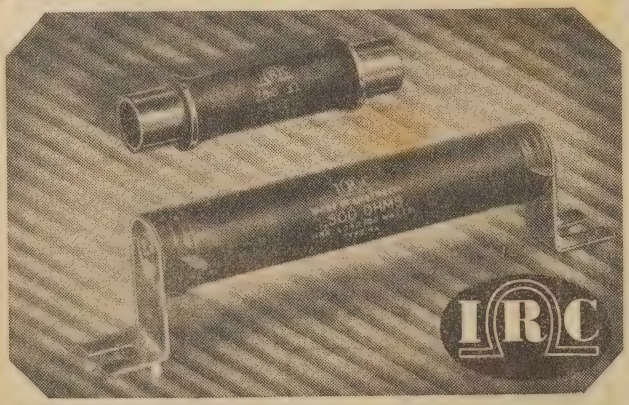

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ıere is dangerous, but a brief re-
ninder won't do any harm. There is
ıo point in being scared of it but, at
he same time, one should develop a
ıealthy respect for it and not take any
·hances. Never work on the under-
ide of the chassis unless the plug is
·emoved from the powerpoint, and be
ure to use a three-core cable so that
ne lead may be used to earth the
:hassis.

The transformer as you receive it will have a number of different ·olored leads attached and an accom-
panying chart will explain the code. A three-terminal tag strip is used o connect the incoming power flex to he 240-volt leads from the trans-'ormer. Both the leads from the ransformer and the power flex will ıave to pass through holes in the :hassis, and it is essential that they ›e protected from the sharp edges of netal by means of rubber grom-nets.

TRANSFORMER MOUNT

The power cord should be knotted on the inside of the chassis to prevent any strain being placed on the solder-ed connections, while the unwanted HT leads from the transformer should be carefully taped so that they are in-sulated both from each other and from their surroundings.

When using a steel chassis it is not advisable to depend on this for good connections between all the points which are shown as earth symbols in the diagrams. The presence of paint and the tendency to rust will almost certainly lead to trouble sooner or later, and standard practice is to join all these points with bare tinned cop-per wire, usually of about 18 gauge.

It is unlikely that the filament leads on the transformer will be long enough to reach the socket, so they will have to be extended with some short lengths of hookup wire, insul-ating the joins with spaghetti tubing.

ELECTROLYTICS

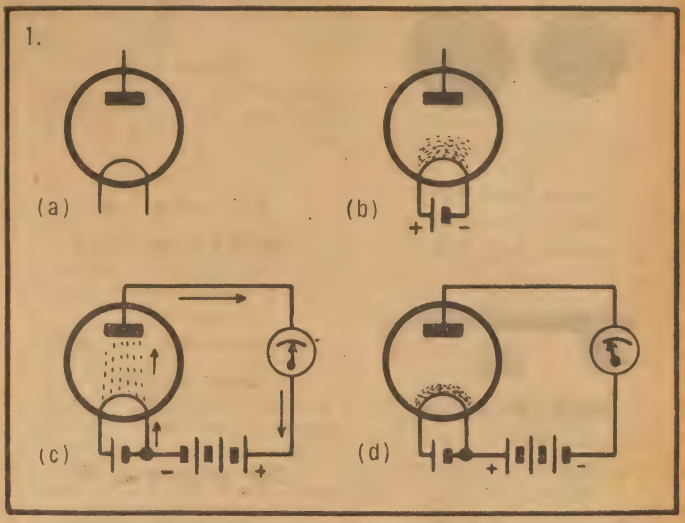
The condenser shown connected across the 3000 ohm resistor is an electrolytic, a type we have not men-tioned before, and it is necessary to observe a definite polarity when con-necting it. One end will be marked positive or colored red, and this end should be connected to the cathode of the valve.

The only alteration to the crystal set wiring is to remove the leads from the headphone terminals and connect them to the two outside terminals of the potentiometer. There is a right and wrong way for these two leads to be connected, the wrong way causing the volume control to work "back to front," as well as having some other undesirable effects. Study the wiring diagram carefully, and you should have no difficulty.

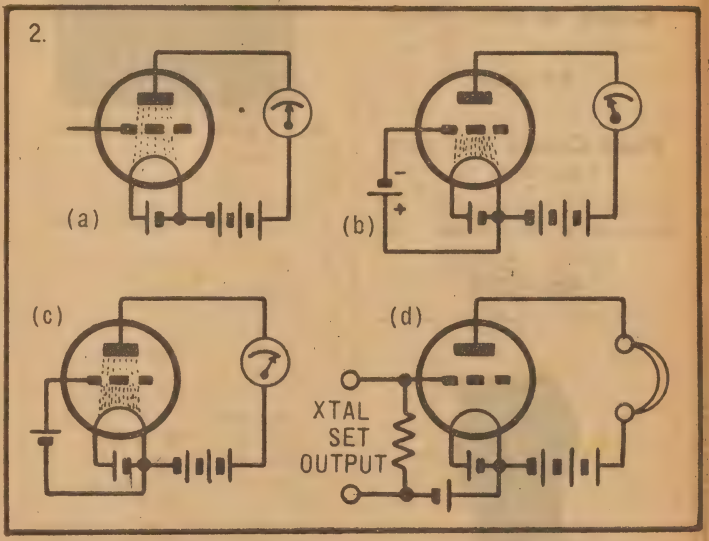
Finally, some comment on the cir-cuit itself. The .1 megohm potentio-meter takes the place of the head-phones in the crystal detector circuit.

The signal currents flowing through it produce a voltage across it and if the full voltage is applied to the grid of the valve, maximum volume will result. However, by setting the ad-justable tapping at some intermediate point along the resistor, a lesser volt-

THE EVOLUTION OF THE TRIODE



Illustrating the behaviour of a simple diode valve.



The diode becomes much more useful when a third element is inserted to form a triode.

age is applied and this is a convenient method of controlling volume. It is used almost exclusively in modern receivers.

The 3000 ohm resistor and the 25 mfd electrolytic condenser together form a self-bias network in order that the valve will have the correct value of negative voltage applied to the grid.

The extra grid in the valve, shown wired to the HT, is known as the screen grid. Its presence in the valve is not essential, but it does improve the performance considerably. If you want to try the valve as a simple tri-ode, similar to that which we dis-cussed in the first part of our article, it can be done quite easily. Simply con-nect the screen to the plate instead of the HT. You will find that the set will work, but that volume will be somewhat reduced.

When operated according to the original circuit this little amplifier will provide considerable boost, in spite of the moderate plate voltage. We don't suggest that it will operate a loud speaker but those signals which were previously just audible will now be raised to a comfortable listening level.

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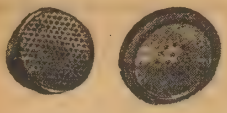

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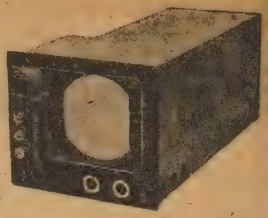

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AF DISTORTION MEASUREMENTS

This is Part I of a series of two articles which will deal with audio frequency distortion measurements. Part II will give details of a simple, practical instrument designed to measure distortion in audio amplifiers.

PART I.

THE acoustical quality of an audio amplifier is related to the amount of distortion prevalent in the amplifier.

If conforming to true Class A operation, the output plate current waveshape of the amplifier should duplicate the waveshape of the grid voltage input.

Such not being the case, the amplifier has a certain percentage of harmonic distortion which, if excessive, deteriorates the audio quality and becomes annoying to the listener.

There are three types of distortion found in an amplifier: (1) amplitude distortion, (2) frequency distortion, and (3) phase shift.

In amplitude distortion, the fundamental plus harmonics are observed in the output. Frequency distortion is caused by the amplifier's inability to amplify all frequencies equally. Phase shift is present when the amplifier has different delays for all frequencies.

The amount of distortion increases as the tube is operated outside of the linear portion of the tube characteristic curve, as shown in Fig. 1.

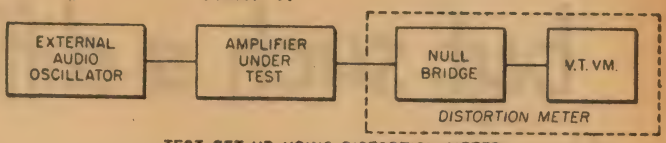
INTERMODULATION

In addition to harmonic distortion, there is intermodulation distortion in audio amplifiers. Both are caused by non-linearity in the amplifier. Intermodulation results in the production of frequencies equal to the sums and differences of a low and high frequency (and harmonics).

The intermodulation products of fundamental frequencies F1 and F2 are as follows: The intermodulation products do not resemble the original tones in the input.

F1 plus F2 and F1—F2.
2FI plus F2 and 2F1—F2
F1 plus 2F2 and F1—2F2, etc.

Intermodulation distortion measurements more closely correspond to the non-linear distortion detected by the average radio listener than does a measurement of total harmonic distortion. It is interesting to note that intermodulation distortion can be observed even after no harmonic distortion is measureable.

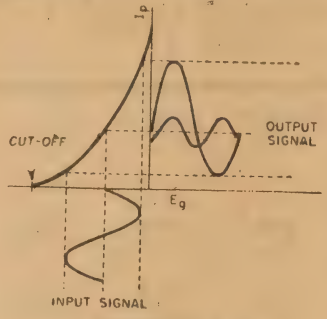


TEST SET-UP USING DISTORTION METER
FIG. 2

The percentage of total harmonic distortion represented as the distortion factor, is equal to:

$$\sqrt{\frac{\text{Sum of squares of harmonic amplitudes}}{\text{Sum of squares of fundamental and harmonic amplitudes}}} \times 100\%$$

The harmonic content of the signal includes all of the components which are higher in frequency than the fundamental. Signal components which are lower than the fundamental, such as noise from the power supply, are not usually measured.



DISTORTION IN NON-LINEAR AMPLIFIER
FIG. 1

Total harmonic distortion measurements are most frequently made at 400 or 100 cycles per second. Even though this is the standard practice, additional distortion will usually be present at the lower frequencies.

The Federal Communications Commission recommends a measurement of harmonics in audio equipment at frequencies of 30, 50, 100, 400, 1000, 5000, 7500 and 15,000 cps.

Audio frequency distortion measurements can be made by using distortion meters, harmonic wave analysers and intermodulation analysers. The distortion meter will be discussed first.

A distortion meter gives the percentage of total harmonic content and does not show how much of each harmonic is present in the output. A block diagram of the meter is shown in Fig. 2.

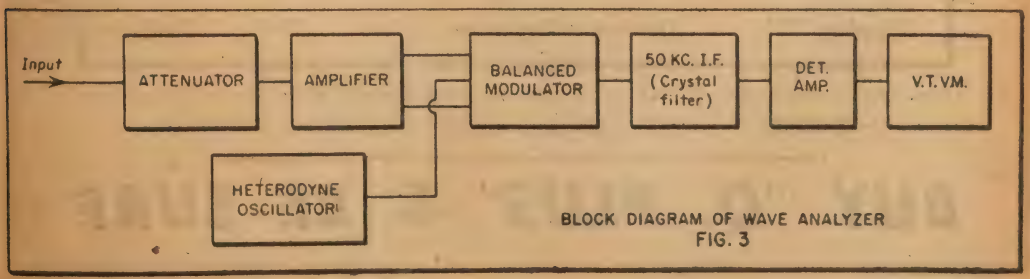
BASIC CIRCUIT

Basically, it consists of a null bridge and a vacuum tube voltmeter. The null bridge is tuned to the fundamental such as 400 cycles per second and the bridge is balanced at this frequency to entirely remove the fundamental. The vacuum tube voltmeter will then measure only the amplitude of the harmonics.

For accurate measurements, the oscillator generating the fundamental test frequency should be completely free of harmonics.

In addition, the VTVM should represent the RMS voltage as truly as possible. This can be ensured by operating the VTVM in a manner such that the square root of the plate current versus grid voltage is a linear function.

The distortion meter does not indicate which frequencies are present in the complex-distorted wave and the relative amplitude of each.



BLOCK DIAGRAM OF WAVE ANALYZER
FIG. 3

Both Alike

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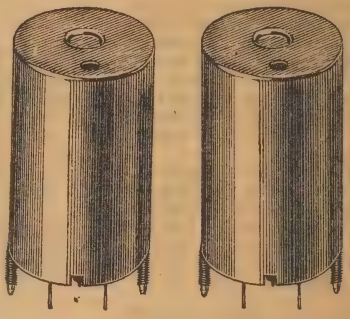

FEATURES	Q-PLUS A.C.5.	Q-PLUS A.C.4.	COIL 1	COIL 2	COIL 3
PERMEABILITY TUNED	**YES**	**YES**	YES	YES	YES
"Q" of sec. at 500 Kcs	176	110	110	110	124
Coil Gain at 600 Kcs	9.75	6.5	5	6.5	7.00
Coil Gain at 1500 Kcs	13.5	11.00	4.5	4.5	5.00
Spheroclad Construction	**YES**	**NO**	NO	NO	NO
Coupling "K"	**Optimum**	**Optimum**	Under	Under	Optimum

These results were checked with a Marconi Circuit Magnification Meter and a specially designed test chassis for gain test and the results are vouched for.

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In addition, certain random noises may be very disturbing to the listener and yet show only a small indication on the meter. Therefore, as in many test measurements, the operator must show sufficient skill to translate the results obtained with the meter into useful data.

A typical commercial distortion meter has a frequency range from 50 to 15,000 cps. The distortion percentage is read directly from a meter with calibrated full-scale deflections of 0.3 per cent, 1 per cent, 3 per cent, 10 per cent and 30 per cent distortion.

A diode vacuum tube voltmeter is used for measuring the percentage of total harmonic distortion. The scale is also calibrated in decibels. A 100,000 ohm unbalanced and a 600 ohm balanced bridge input circuit are provided.

Distortion measurements are made on this instrument with an accuracy of approximately 5 per cent.

A distortion-free sine wave oscillator should be used with the meter. Otherwise, a residual reading will be measured which represents the oscillator distortion rather than that of the amplifier or other audio device being tested. There should be no distortion even at the very low audio frequencies.

WAVE ANALYSER

Unlike the distortion meter, the harmonic wave-analyser is a precision method of measuring distortion and indicating separate components. The wave-analyser tells the operator which frequencies other than the fundamental are in the complex wave-form and also gives the amplitude of each harmonic.

Since the analyser must determine the fundamental frequency and all of the harmonics, it is necessary that the instrument be capable of tuning to each of these frequencies and of measuring the amplitude of each.

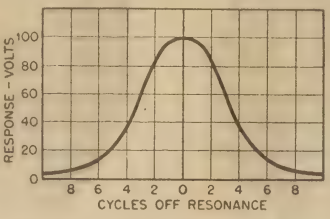
The analyser is really nothing more than a highly selective vacuum tube voltmeter, and is similar to the conventional superheterodyne receiver except that the intermediate frequency is much higher than the input audio signal under observation.

The wave-analyser has a very narrow band-width, otherwise measurements of harmonics components at the very low audio frequencies would be impossible.

The most commonly-known wave-analyser is the heterodyne type. A block diagram is shown in Fig. 3 and is representative of a commercial analyser.

The incoming audio signal is heterodyned with the frequency from a variable frequency oscillator and the resultant frequency is amplified by the narrow bandwidth IF amplifier and read on a vacuum tube voltmeter.

When the difference between the oscillator and the input signal frequency is 50Kc, the signal will be tuned to the IF amplifier and the amplitude can be measured on the VTVM. The three crystal filter incorporated in the IF amplifier assures a very high selectivity. A response curve of the crystal filter is shown in Fig. 4.

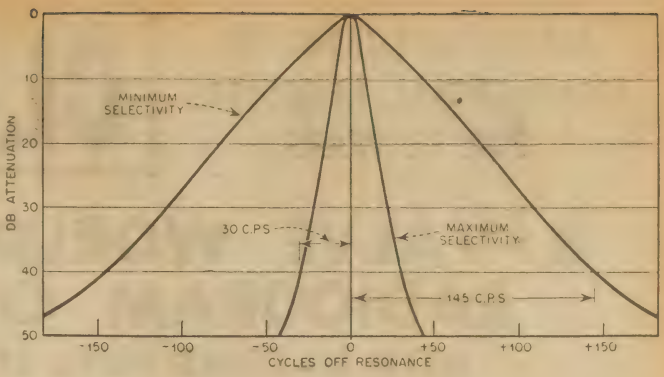


CRYSTAL FILTER CHARACTERISTIC
FIG. 4

The heterodyne oscillator covers a frequency range of 34,000 to 49,980 cycle per second, but the dial is calibrated from 0 to 16,000 cps.

Assume that the incoming signal is 500 cps. This would correspond to an oscillator frequency of 49,500 since 49,500 plus 500 cps equals 50 kilocycles. A difference frequency f1-f2 (49,500—500) cannot be amplified. The bandwidth is only 4 cycles and harmonics can be measured easily at the lowest audio frequencies.

The input impedance is one megohm, which is sufficiently high to make loading effects negligible. The VTVM is directly calibrated in volts and decibels and a 5 per cent voltage accuracy is obtained on all ranges from 300 microvolts to 300 volts full-scale. The frequency calibration is accurate to plus or minus (2 per cent—1 cycle).



VARIABLE SELECTIVITY RESPONSE CURVES
FIG. 5

Another commercial wave-analyser has the feature of variable selectivity for rapid analysis of the complex wave. Where the harmonics are spaced far apart, the bandwidth may be increased, thus making it easier to make measurements.

If the harmonics are closely spaced, as at the very low frequencies, the instrument may be made more selective, to separate harmonics 30 cycles apart. A response curve of this analyser is shown in Fig. 5.

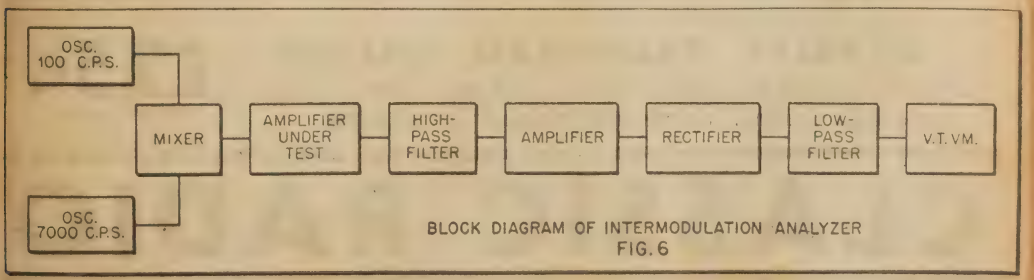
The operation of a wave analyser involves first, tuning the oscillator dial to the fundamental, and then adjusting the attenuator until the meter reads full scale. Then the harmonics are found by changing the oscillator frequency dial and recording the amplitude of each.

In addition to its use for measuring the distortion in an amplifier, the wave-analyser can be used for measuring distortion in oscillator, transmitters and telephone systems. It can also be used to determine the harmonics in power machinery and to analyse noise characteristics.

TYPICAL METER

A block diagram of a typical commercial intermodulation distortion meter is shown in Fig. 6. The amount of distortion is maximum at the highest and lowest transmitted frequencies. However, this discussion will be concerned mainly with intermodulation distortion measurements

(Continued on Page 99)



BLOCK DIAGRAM OF INTERMODULATION ANALYZER
FIG. 6

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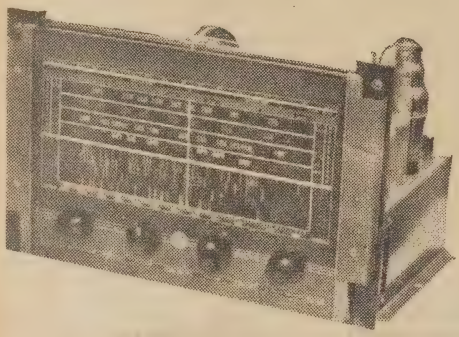

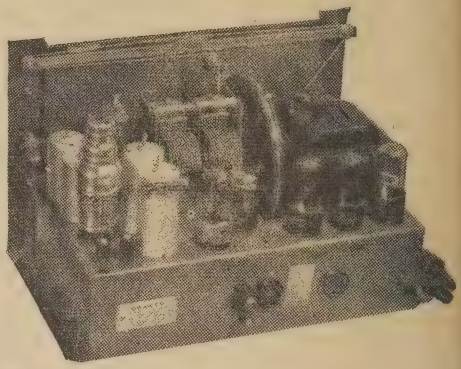

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- Speakers supplied are Magnavox 12" and 8" permanent magnet with tropic proof transformer. Single 12" supplied with 6 valve chassis.
- Power switch is fitted to the tone control of all chassis thus enabling the power to be completely switched off from the set. Radiogram switch combined with wave change switch.

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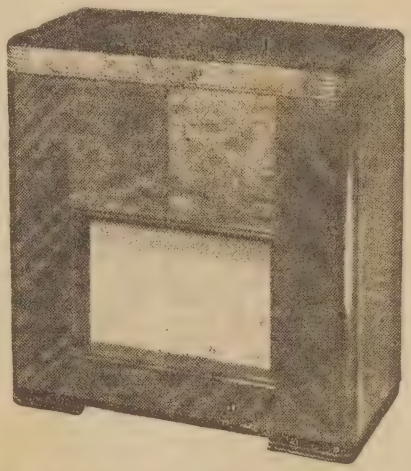

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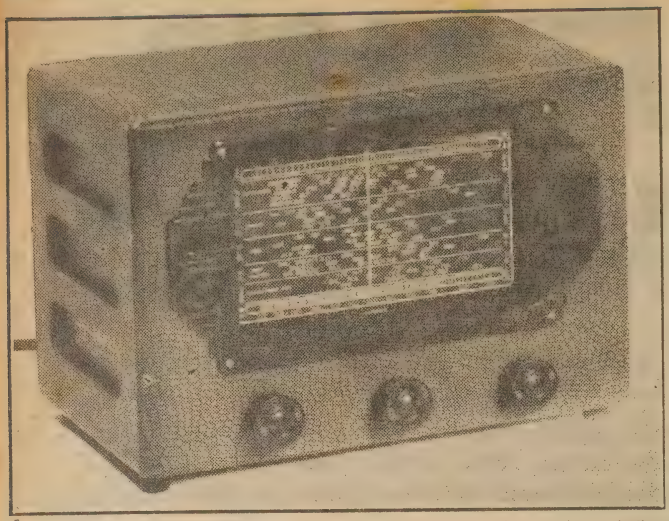


We hadn't time to work out any really fancy cabinet designs, but in this "pilot" model emphasis is on a large, easy-to-read tuning dial made possible by removing the speaker from the front. There is a speaker fret at each end.

THE TWIN SPEAKER MANTEL

Designed to meet a popular demand, this new small set has the advantage all round over the usual run of 4-valve mantel receivers. It features an extra valve for added gain, the larger cabinet gives better baffling and a second speaker may be added to lend a spatial effect to the sound.

by Raymond Howe

We certainly couldn't quarrel with readers' demands for an "in-between" type of receiver, because it transpired that three members of our technical staff were using sets of this type in the home. Their explanation, quite simply, was that the larger cabinet was still small enough to carry around but it certainly made for better reproduction.

However, there wasn't much point in regarding any of these sets as a prototype because they had all been built in oddment wooden or bakelite cabinets picked up from goodness knows where. If readers were to be supplied with a new design, we obviously had to begin again from scratch.

BEHIND THE DIAL

The usual approach is to place the dial and speaker grille side by side, but this generally entails using a small dial and it becomes quite a job, in a fabricated cabinet, to achieve any sort of balance between the dial and speaker openings.

The alternative of placing the speaker behind the dial is smart enough, if all the parts are made especially for the purpose, but it isn't the ideal acoustically.

Faced with these little difficulties, we decided on a completely different approach, placing the speaker at one end of the cabinet. This would leave the front completely free for a large dial, obviating any difficulites of finding the station you want.

By placing another speaker grille at the opposite end of the cabinet, and closing in the back, the rear wave from the cone would be put to use instead of losing itself out the back. Better still, we could provide for a speaker at this end also and obtain all-round coverage!

The suggestion of using two speakers in a set may sound rather ironic at the moment, because of current shortages. However, it is generally true that it is easier to obtain two small speakers at the moment than one large one and it is also true that many readers will already have one on hand.

However, this can remain a purely optional point and the set used for as long as you like with just the one speaker in operation. There need be no fear of all the sound seeming to come from one end of the cabinet. You will find that there is plenty of output also from the relief grille at the other end.

Having made these "policy" decisions, the design follows as a matter of course and you will note that we have striven to keep the layout and circuit along simple lines.

MINIATURE VALVES

The electrical design of the set centres around the use of the high-gain miniature valves which are now in plentiful supply.

There was little point in using miniature coils and IF transformers, as the size of chassis necessary to accommodate the speaker, power transformer and dial still allowed sufficient room for the standard components.

Looking at the rear semi-plan view of the set, the valve sequence runs from the centre right to the rear and thence along to the rear left-hand end where the main speaker is mounted. The power transformer and the optional second speaker take up the opposite end of the chassis. Aerial and oscillator coils are mounted on a simple bracket underneath the chassis and below the tuning gang.

This layout permits a 5-valve set with a large-size dial and provision for two speakers to be constructed on a chassis measuring only 10½ inches by 5½ inches. Even so, there is no cramping of components in the underneath wiring, as the underneath photograph will show, thanks to a straightforward circuit design and the use of miniature valves.

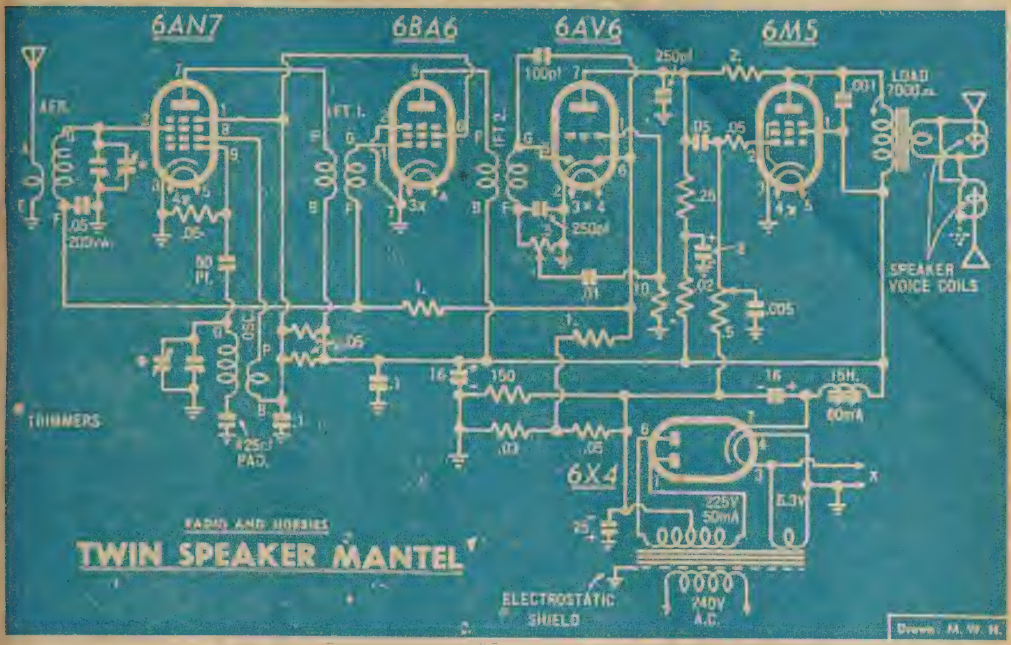
CONVERTER

In the converter socket we have used the 9-pin 6AN7 triode-hexode converter, with which readers are becoming quite familiar by now. The screen and the oscillator anode are fed from a common point which should end up at about 85 volts "on signal."

The remainder of the wiring of this stage is standard and, with the exception of the padding capacitor, warrants no further comment.

We have in recent issues men-

CIRCUIT DIAGRAM FOR THE TWIN-SPEAKER SET



The circuit is straightforward and easy to make.

tioned the policy of some manufacturers to set the coil inductance at the factory, seal the slug and recommend the use of a variable padding capacitor for the alignment adjustment.

However, you can please yourself on this point but bear in mind that, if you do use a fixed padder and vary the oscillator slug, obtain a 425 pf value with a 5 pc tolerance or lower.

The IF stage carries a 6BA67-pin miniature valve. All of the gain of which this valve is capable is not required, but it can be "quietened down" with about an extra volt of bias. The resulting overall gain of the IF stage is about as much as can be safely tolerated with standard IF transformers.

SCREEN BYPASS

There is only one component associated with the wiring of the 6BA6 socket, namely the .1 mfd tied to the screen pin. The screen voltage is obtained from the 85 volt junction point of the feed to the 6AN7 screen and oscillator anode. In effect, the .1 mfd bypasses the common 85 volt feed point for the two stages, but we prefer to see it mounted near the IF socket.

From the IF stage, we feed into the 6AV6, the 7-pin miniature duo-diode high-mu triode. The diode plates are employed both for detection and AVC (automatic volume control). The general layout of the chassis rendered unnecessary any RF filtering for the diode load. As usual, this diode load is the volume control potentiometer.

No pickup terminals are fitted to the set, such provision being mainly confined to console models where larger speakers can do justice to the reproduction of records.

However, if you have ideas in that direction, you could use the same method of switching as is employe with switch S2a and S2b in the ci cuit of the "1951 Advance" in th March, 1951, issue.

The pickup terminals could b mounted on the top rear edge of th chassis near the can of IFT2 an with the DPDT switch on the rea face of the chassis below the term inals. The group could be mad

PARTS LIST

1 Chassis 10½" x 5½" x 2¼".
1 Cabinet to suit.
1 Power transformer 225V a side at 50mA, 6.3V at 2A. (PF 201 or similar.)
1 60mA filter choke.
1 Miniature 2-section gang tuning capacitor (AWA or similar).
1 dial to suit (USL32A or similar).
1 Broadcast aerial coil, 1 broadcast oscillator coil.
2 Standard 455 kc IF transformers, No. 1 and 2.
2 Gang trimming capacitors.
2 5-inch speakers with one 7000 ohm transformer.
3 7-pin miniature valve sockets, 2 9-pin "innoval" sockets.

VALVES

1 6AN7, 1 6BA6, 1 6AV6, 1 6M5, 1 6X4.

CAPACITORS

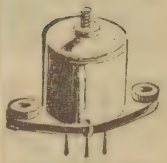
1 25 mfd 40PV electrolytic, 2 16 mfd 525PV electrolytics, 1 8 mfd 350 or 525PV electrolytic, 2 .1 mfd 400VW, 1 .05 mfd 400VW, 1 .05 mfd 200VW, 1 .01 mfd tubular, 1 .005 mfd tubular, 1 .001 mfd tubular, 1 425 pf mica low tolerance, 2 250 pf mica, 1 100 pf mica, 1 50 pf mica.

RESISTORS

1 10 meg. ½ watt, 1 2 meg. ½ watt, 2 1 meg. ½ watt, 2 . 5 meg. potentiometers, 1 .25 meg. ½ watt, 2 .05 meg. 1 watt, 3 .05 meg ½ watt, 1 .03 meg. ½watt, 1 .02 meg. ½ watt, 1 150 ohm 3 watt wirewound.

SUNDRIES

3 Knobs, 2 dial lamps 6V .15A, 1 5A, 1 5-tag, 2 3-tag, 1 2-tag strips, 1 1" threaded mounting pillar, 3-core power flex and plug, 2 terminals (1 red, 1 black), 1 ft shielded hook-up wire, 3 5/16" rubber grommets, scrap aluminium for coil bracket, hook-up wire, spaghetti, solder, solder lugs, nuts, bolts, &c.



Dual-wave units.

Coil former.

3-in-one trimmer.

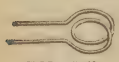
Resistance strip.

Short-wave Coil.

Trimming condenser.

Resistors.

Standard broadcast coil.

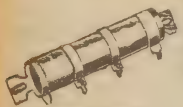


F.M. Coil

5 band coil.

Dual wave unit.

Dial drive drum.



Voltage divider.

Potentiometer.

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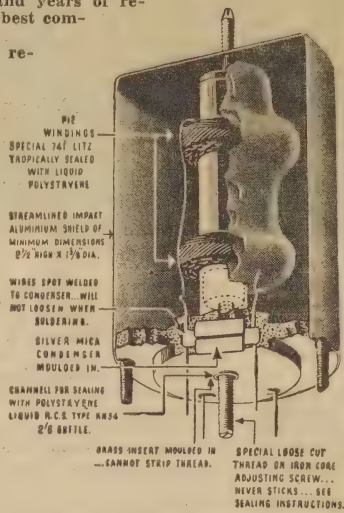
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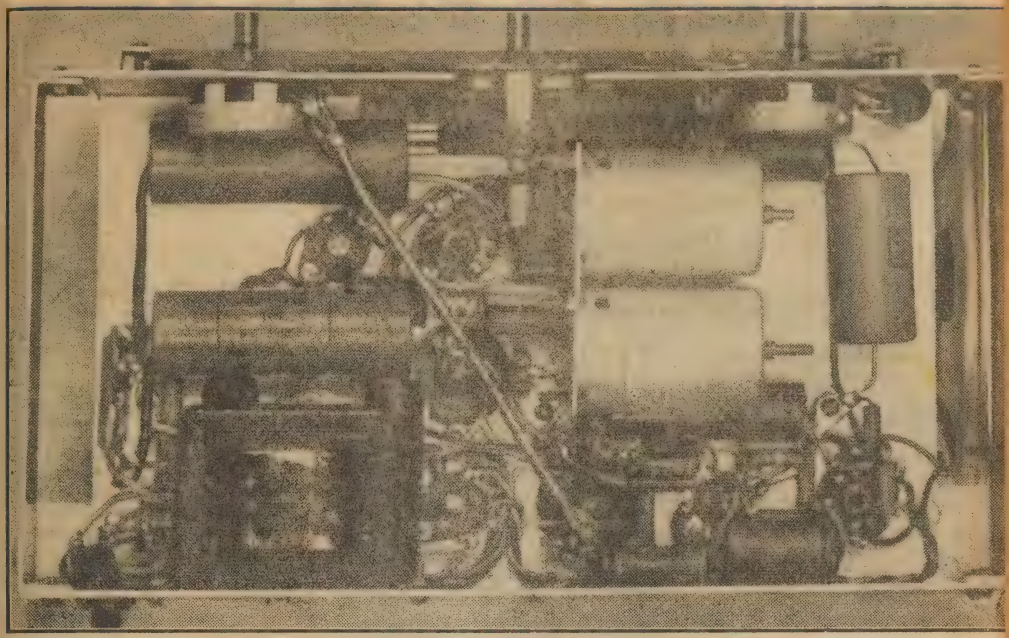
UNDER CHASSIS VIEW OF THE RECEIVER



There are so few parts that nearly all can be traced in this photograph.

accessible through a cutout in the cabinet back cover.

The AVC diode anode is fed from the detector diode anode through a 100 pf capacitor. You may have noticed in other circuits that this drive is taken from the anode of the IF valve. In practice, there is little difference in the AVC action and the selection of the drive point is dictated here by wiring simplicity.

The AVC diode-anode load resistor is returned to a tapping on the back-bias network to provide a delay voltage for the AVC action and standing bias for the two preceding valves. This amounts to just over 2.5 volts, being about right for the converter but about 1 volt additional bias for the 6BA6, for reasons previously mentioned.

SIMPLIFIES WIRING

This method of obtaining bias for the converter and IF valves avoids cluttering up the valve sockets with components otherwise necessary with the cathode bias. It is fortunate that the circumstances permit this saving in a few components.

The triode portion of the 6AV6 gives all the audio gain that could possibly be required. Any further audio voltage gain might lead only to instability or microphonic troubles.

The output stage employs the familiar 6M5 power pentode. It is a high mutual conductance type and will give an output approaching that of the 6V6-GT and 6AQ5 but with very little drive.

The grid stopping resistor in series with the connection to the grid is in keeping with the usual precaution with such valves to prevent parasitic tween say, .01 megohm and about tween, say, .0- megohm and about .05 megohm can be used.

The stage is biased from the back-bias network and the all-round reduction in HT supply keeps the total current drain of the set down to around the 50 mA mark. You will find that there is plenty of audio power available to saturate the sound capacity of even two 5-inch speakers in the mantel cabinet.

PRECAUTION

The bypass capacitor across the output of the valve is there solely as a precautionary measure. It was not necessary in the original set for the sake of stability, but it was included in the circuit diagram in case you encounter mild instability due to some indiscretion in the wiring. Its effect on the treble response is not noticeable.

Speaking of treble response, the potentiometer in the valve grid circuit with the moving arm connec to the "lower" side through a .0 mfd capacitator is a treble-cut to control. Quiet a simple arrangeme but very handy for reducing t effect of sharp burst of static or oth electrical interference as well as adjusting the "tone" of the receiv program to suit your ear.

If the contrast in tonal variati is not sharp enough for you, y could increase the value of the capa tor to .01 mfd.

The 2 megohm resistor between t plates of the two audio valves giv just on 9 db of negative feedba This reduces the sensitivity but it of little consequence as there more than enough audio gain. T feedback smooths out the respon lowering the normal treble rise a lifting the bass where it would othe wise fall off by reason of the sm speaker transformer.

TWO SPEAKERS

Coming to the speakers, there a a few points worth mentioning. the first place, the use of two spea ers is optional, but if you have second speaker on hand, the co bination of the two will enhan the reproduction. There is a bet distribution of the sound, which ten to reduce the impression of a sin source.

We suggest that the speak mounted at the end opposite to t power transformer be regarded the main speaker, in order to ke the leads to the speaker transform from wandering from one end of t hassis to the other. The two spea

RESISTOR COLOR CODE

VALUE	BODY	END	DOT
10 megohm	brown	black	blue
2 megohm	red	black	green
1 megohm	brown	black	green
.25 megohm	red	green	yellow
.05 megohm	green	black	orange
.03 megohm	orange	black	orange
.02 megohm	red	black	orange

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ers are then connected together by paralleling the voice coils.

When the two speakers are connected in parallel across the one winding, it must obviously halve the load presented to the valve, but, in a case like this, the operating conditions are sufficiently indefinite and elastic as not to warrant too much concern on this account.

To be precise, the twin-speaker set-up could be operated from a single-ended 14,000 ohm transformer, but it is doubtful whether the audible results would warrant the complication, in view of the fact that such transformers for an AC valve would not be readily available.

VOICE COILS

There is no need for the speakers to be of the same brand, although, of course, they should have the same voice coil impedance. It would even be practical to use a 6in and a 5in in parallel, as there is just room on the chassis to fit the larger one in.

In the connection of the two speakers the question of phasing of the cones enters into the picture. To select the correct connection in the original set we brought to the rear a pair of leads from the voice coil of each speaker, fitted the set into the cabinet and temporarily put the back cover in place.

With the set tuned to a station the second speaker was paralleled with the main speaker first one way and then the other. The "in-phase" connection unmistakably gave the best reproduction. When connected "out-of-phase" the overall bass response fell away badly.

Incidentally we checked the phasing of the speakers by touching a cycle battery across the parallel connection of the voice coils and noting in which direction the cone of each speaker moved. You will find that they should both move outwards at the same instant, and both move inwards together, according to the polarity of the battery.

The power supply section is a straightforward affair untilising the miniature 6X4 rectifier and a 225 volt a side 50 mA power transformer. This transformer was selected because of its comparatively small size consistent with adequate rating for the circuit design.

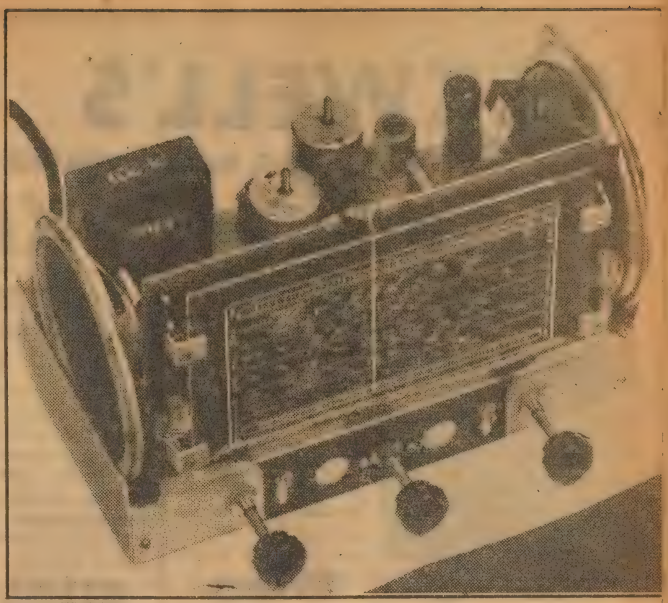
With the full drain of the set and using a filter choke having a nominal DC resistance figure of 300 ohms, the HT voltage to the set was just on 240 volts. With filter chokes having DC resistance figures of 500 and 600 ohms, the available HT will be reduced below the 240 mark by some 10 to 15 volts.

FILTERING

The 16 mfd filter capacitators and the decoupling in the plate circuit feed to the NAV6 triode section are necessary to keep the hum down to a low level. Fortunately, there is sufficient space under the chassis to take this size of filter capacitor.

In the back-bias network of the transformer centre-tap return, two resistors would normally provide the required bias for the output valve and the first two valves. However, the comparatively low values in which we are dealing would necessitate stipulation of wirewound resistors or low tolerance carbon to ensure sufficient accuracy in developed voltages.

The cheaper way of meeting the situation is to use one wirewound resistor and connect across it two cheap ½-watt resistors to obtain the lower voltage tapping for the first two valves. An added advantage is that the sensitivity of the front end of the set can be adjusted simply by changing the value of the .03 megohm resistor. Reduce the value to increase sensitivity and vice-versa. Instability is the limit for increase in sensitivity. Remember that any adjustment should be made with the aerial disconnected or the set tuned off a station so that AVC bias will not mask changes in the standing bias.



Here the general layout of the chassis, with its two speakers, can be seen. Only one need be used if two aren't available. Any standard tuning dial will fit.

CONSTRUCTION

So much then for the electrical design of the set. On the constructional side a few points deserve mention.

Firstly, in the case of the large dial it was necessary to make a small but simple modification in the form of dispensing with the flywheel. To retain this part of the dial would have meant increasing the "dead" space within the cabinet out of proportion to the actual value of the flywheel.

To prevent the dial drive shaft from working its way outwards, a little "dog" collar complete with securing grub screw should be fitted to the rear of the shaft in place of the flywheel.

The underchassis photograph gives a good idea of the placement of the components, both large and small. The aerial and oscillator coils mount on a bracket located beneath the tuning gang and close to the converter socket. This ensures short leads and provides a measure of shielding. Two holes in the right hand end of the chassis allow access to the slugs for alignment purposes.

Locate the coils on their bracket so that the "grid" connection is nearest the chassis. The aerial lead from the aerial coil takes a harness run through the power supply wiring to the aerial terminal located at the rear corner of the chassis near the power transformer.

THE CONTROLS

The tone and volume control potentiometers should be of the medium sized type to fit in with the physical design of the chassis and the component layout. The size in question is available on the market in a number of popular brands. Fit the tone control potentiometer before placing the aerial coil in position. The aerial coil is the one nearest the dial.

The filter choke mounts on the rear inside face of the chassis below the power transformer and the II valve. Almost any brand of 60 mA choke will fit in this position, the only chassis modification being in the position of the second mounting hole. Bear in mind previous remarks concerning the DC resistance of the filter choke and the resulting HT output voltage from the filter.

The mounting holes of each valve socket are on a line at 45 degrees to either axis of the chassis. Mount the sockets so that the gap between the first and last pins point in the following directions — towards the left-hand front corner of the chassis for the 6AN7 and 6M5, toward the left-hand rear corner for the 6X4 and 6BA6, toward the right-hand front corner for the 6AV6.

Place solder lugs under the nut

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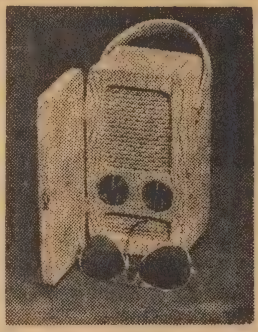

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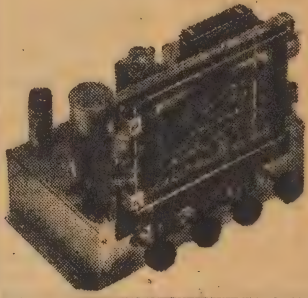

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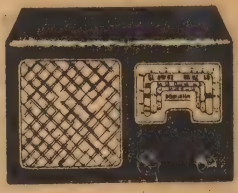

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of both mounting bolts of the 6AN7 socket and under the "inside" mounting bolts of the 6AV6 and the 6M5 sockets.

The mounting holes for the IF transformers are in a line parallel with the short axis of the chassis and the transformers should be located so that the leads from the "P" pin of No. 1 to the 6BA6 socket and from this socket to the "G" pin of No. 2 are as short as possible.

Place a solder lug under the rear securing nut of the No. 1 IF transformer. Connect all solder lugs and any other earth point together with a run of light gauge tinned copper wire to obviate any later trouble resulting from a "bad" earth to the chassis.

WIRING IS SIMPLE

There is not a great deal to the actual wiring of the set, that of the "front" end consisting mainly of wiring runs from one point to another. Don't forget to earth the centre spigot of the miniature sockets, with the exception of the rectifier socket where it doesn't matter.

The 5-tag mounting strip secured under that mounting bolt of the power transformer nearest the second speaker carries the three resistors associated with the back-bias network. A spare tag on the end carries the junction of the second 16 mfd capacitor and the lead from the filter choke and constitutes the point of HT output from the power supply.

A 3-tag mounting strip is secured under the transformer mounting bolt near the aerial terminal to take the junction of the primary leads of the transformer and the incoming power flex.

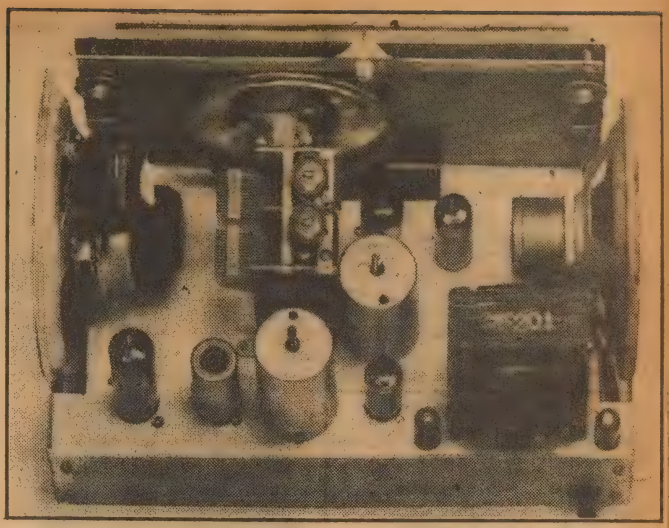
We suggest the use of 3-core power flex mainly from the viewpoint of safety. The green-colored earth lead of the 3-core is soldered to the earth tag of the strip and connects to the household earth system via the "earth" pin in the 3-pin flat plug and the wall power socket.

TAG STRIPS

Each mounting lug of the No. 2 IF transformer carries a mounting strip, a 3-tag on the inside one and a 2-tag on the one near the rear edge. The 3-tag takes the wiring to the 1 megohm AVC diode load and AVC decoupling resistors. The 2-tag strip supports the shielding wiring from the volume control for connection to the .01 mfd. coupling capacitor to the 6AV6 grid.

The shield braid of this wiring is secured to the earth tag of the 2-tag strip after pulling the wiring fairly taut in its elevated run from the control. The "earthy" lug of the control should be connected to the braid but do not connect the braid to the earth cover of the control. This single-point earthing of the shield braid can keep you out of some hum trouble arising from magnetic eddy current in the chassis.

The use of ½-watt resistors in the wiring of the AVC and audio circuits means easier wiring in the somewhat confined space. The under-chassis photograph will help you here if you feel that you are lacking in a little experience in component layout.



This rear view shows how the parts are mounted "on the deck." We used two makes of speakers just to be different. Dial is large, but is in contrast to tiny scales on most mantel sets.

A 1in length of threaded pillar is used in the plate circuit wiring of the 6AV6 triode. It carries the junction of the .25 megohm plate load, the .02 decoupling resistor and the 8 mfd decoupling capacitor.

The .1 mfd HT bypass capacitor is located partly underneath the oscillator coil, the "earth" side going to an earth point at the 6M5 socket and the "hot" side to the "B" terminal of the No. 2 IF transformer.

Pin 9 of the 6M5 socket is a "blank" pin and can be used to carry the junction of the .05 mfd coupling capacitor, the run to the tone control and the .05 megohm parasitic resistor. Do not use another "blank" pin for such junctions as pin 8 is a second cathode connection and pin 6 is too close to the plate pin 7.

> We are planning to prepare a wiring diagram for this receiver to assist those who still find difficulty in following a schematic circuit. Watch out for it in the next issue. Cabinet and chassis details will also be supplied to manufacturers so that these items can be made available for you.

The .001 mfd capacitor connecting from plate to screen of the 6M5 is shown in the photograph as a mica type. The parts list gives this capacitor as a paper tubular type as it is cheaper than the mica.

The 25 mfd electrolytic capacitor across the back-bias network is actually connected from the lower end of the tone control to the shield cover on this control, the positive end going to earth. The negative side of the 8 mfd decoupling capacitor in the plate circuit of the 6AV6 is also earthed to the tone control cover as a matter of convenience. With a steel chassis you could solder direct to the chassis or drill a hole and mount a solder lug.

On completion of the wiring of the set make sure that all components are mounted securely and that there is no chance of a rattle developing anywhere, particularly in the dial itself, from the sound pressure built up by the speakers when the volume is turned up a bit.

Allowance has been made in the cabinet dimensions to allow the fitting of stiff cardboard or light ply baffles with a 5in circular cutout over the speaker frets. See that when the set is slid into the cabinet the speakers just slide into position nicely without damage to the cone facing ring.

Incidentally, on the matter of dial lamps, it is suggested in the parts list that the 6V .15A size be used. The point here is that although the 6.3 volt heater winding is running at full nominal load is supplying the valves the transformer manufacturers is quite happy about the extra slight load of a couple of .15A lamps.

Alternatively, you could use a couple of 3.8V .25 or .3A lamps wired in series across the 6.3 volt winding. The loading will be much the same as with the parallel-connected 6V .15A lamps.

ALIGNMENT

The question of superhet alignment has been covered many times before and to save endless repetition we have made an alignment pamphlet available through the 1/- Query service for those readers who are not sufficiently familiar with the procedure. The golden rule in this procedure is to adjust the coil slugs at the low frequency end of the dial and the gang trimming capacitors at the high frequency end.

Completely aligned and fitted into a cabinet, you will find this set capable of excellent performance and worthy of a place in any home.

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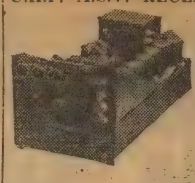

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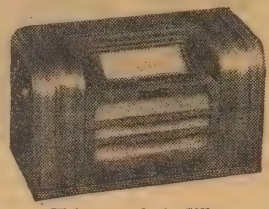

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FROM THE SERVICEMAN WHO TELLS

STOP me if you have heard this one but, if I have mentioned it before, it is only because it is a more common fault than it ought to be.

The set was a five valve dual wave mantel model, and had apparently failed completely. Removing the chassis from the cabinet I switched on and tuned over the band. As the owner had remarked, 'it wouldn't get a thing" either on broadcast or short-wave.

I put my finger on the audio grid, and the speaker "burped" in the usual manner. Then I tried the finger technique on the IF valve and a moment later I wished I hadn't. There was certainly plenty of life there, but not the kind I wanted. Somehow or other the grid circuit was mixed up with the HT and, as I had been holding a control shaft with the other hand, I stopped a nice little wallop.

UNWANTED VOLTS

When I recovered some of my composure, I approached the chassis armed with a voltmeter, plus a certain amount of caution and checked the voltage on the offending grid. It was just under 250 volts positive and, on checking the converter grid I found it to be the same. Some voltage was to be expected here, since the two stages would be coupled through the AVC line but I was rather disappointed to find that they were both the same.

Had one been higher than the other, it would have indicated the stage nearest to the breakdown. This check can only be made if the AVC line has a decoupling resistor between the two stages, in which case the drain of the voltmeter will cause a reduction in voltage on the side remote from the source.

Next, thinking that the trouble might be an internal short in one of the valves, I removed both the IF amplifier and the converter, and checked from the grid leads to chassis. The voltage was still present and I realised that I would have to delve a little deeper into things.

ON THE TRACK

Removing the HT from the IF amplifier section had no effect but, when it was removed from the converter, the fault vanished. With this valve already removed from its socket there were not many places left for the fault to occur and I realised that it was probably a broken down IF transformer.

Just to make sure, I disconnected the IF primary from both the HT and the converter plate. Sure enough the fault vanished but re-appeared as soon as I connected the primary winding to the HT.

By this time I was beginning to feel a little annoyed for not having found the trouble sooner for as I stated earlier, this is not the first time I have struck this fault. On the other hand, it is always easy to be wise after the event.

However, to continue. The IF can was removed and a careful examination made of the fine wires leading from the bobbins to the base pins. As I had expected, the leads from the grid winding, which happened to be the upper one, lay across the edge of the plate winding, and were in fact cemented to it with the impregnated wax.

The ohmmeter showed continuity between the two windings, and as I peeled one of the wires clear of the lower bobbin the fault vanished. Careful inspection showed where the insulation had broken down between one of the outside wires of the bobbin and the lead wire from the bobbin above.

REPAIR

I melted some wax over the bare spot on the bobbin, and enclosed each of the leads in a length of plastic tubing. Thus protected I could see no reason why the transformer would not be as good as new, or probably better, as it now had the benefit of some decent insulation.

It occurred to me that the other transformer would probably be constructed in a like manner, and could quite easily suffer a similar breakdown at a later date. Accordingly I removed the can and found, as I had expected, that the leads from the top bobbin were hard against the lower bobbin, exactly as in the other unit.

It did not take long to fit additional insulating sleeves, and I felt a lot more confident about the job.

VALVE DAMAGE

There is, of course, a limit to the amount of preventive action which one can undertake on a set for, if such a course is pursued to its logical conclusion, one could spend many hours searching a chassis for possible weak spots. However, in a case like this, where there is a definite pointer to a possible source of trouble, it is often as well to follow it up.

With all the connections replaced and the valves plugged in, the set was switched on but, alas, no sig-

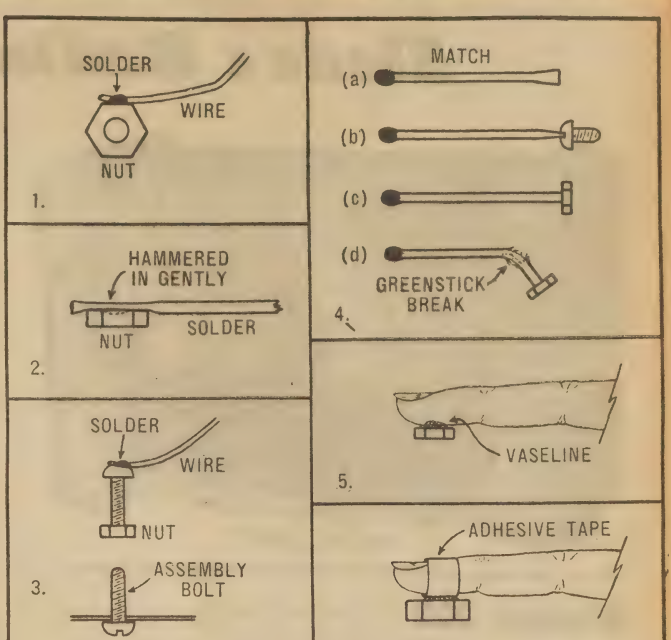

Fig. 2. Methods of mounting nuts and bolts in difficult places.

This month's story shows how a simple fault can have expensive repercussions, and how easily a manufacturer can lose customer goodwill. There are some more suggestions for fitting awkwardly placed nuts and a tip on replacing speaker transformer windings.

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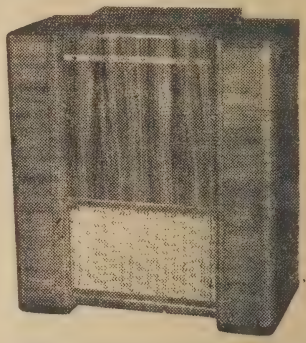

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nals! A quick check with the volt meter showed that all HT voltages were normal, but the bias across the IF valve cathode resistor was very low, only about half a volt. Checking the valve in the tester showed that it had only about 10 per cent of the normal emission, and the converter was in much the same condition.

This was an after-effect that I had not encountered before but was undoubtedly due to the valves having 250 volts positive applied to the grids. Presumably, the previous sets had been switched off promptly when they failed, while the one on the bench had been let run for some time, probably due to its being unattended.

With two new valves fitted the set behaved quite noramlly and, after the usual alignment and general check-over, was returned to the customer.

When detailing the charge, I had to explain that two valves had been ruined by the original fault and that the major part of the cost was for these rather than the repairs to the transformer. While the customer appeared quite satisfied that he had received a fair service job, he certainly chalked up a black mark against the makers of the set.

THE MORAL

And there, I think, is the moral of this little story. "Don't spoil the ship for the sake of a few pennyworth of tar." In this case it was an even lesser value in plastic tubing but the lack of it not only caused the owner the inconvenience of being without a set, but involved him in pounds of expense.

In all fairness, I think I should state that the large majority of coil manufacturers have been providing adequate insulation in their products for a long time and I notice that the most recent models of the above-mentioned set have now been modified in this way.

Apparently my experience was not the only one.

My recent problem with the hard-to-fit nut has brought forth some comment from readers, and the Technical Editor has passed these letters on to me.

Looking them over, and adding some that I have collected or evolved over the years, I find that I have quite a handy little collection, and I feel that some, at least, will be new to most readers.

Most of us have our own pet idea about this problem, but there usually comes a time, when for one reason or another, it lets us down. When this happens the more tricks one has on hand the better, as it is almost certain that one of them will do the job.

AGAINST TIME

The first one is suggested by Mr. M. Johnson, of Vale Park, South Australia, and the general idea is shown in figure 1. Mr. Johnson tells how he was forced to remove a photo-cell socket from a movie projector in the middle of a show, with only the ten minutes or so between changeovers in which to effect the repairs.

As is often the case, the removal was easy, and the repair itself only of a minor nature, but the replacement presented a sticky problem. Normally it would have necessitated the removal of the flywheel and part of the rotary stabilising equipment, but this could not be done in the short while available.

The nuts themselves were fished out through a small hole with a piece of wire, and then Mr. Johnson conceived the idea (born of absolute necessity no doubt!) of soldering the same wire to the edge of the nut. This enabled the nut to be passed back through the hole and on to the bolt. When the assembly was tightened, the wire was simply wrenched off.

The second nut was treated in a like manner and the machine threaded in time for the change over. Nice work, Mr. Johnson, or as C. J. Dennis would say, "I dips me lid."

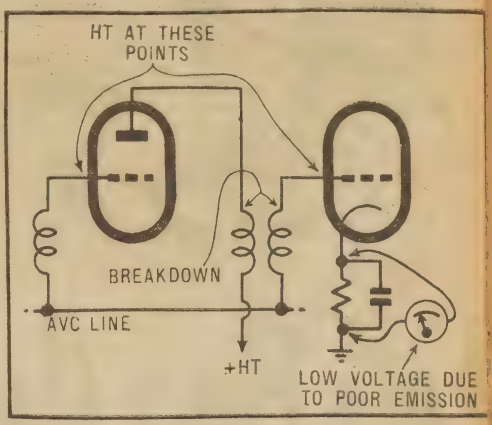


Fig. 1. How the broken down IF transformer was detected with a meter.

I have used that scheme myself on occasions and, as Mr. Johnson points out, it has the advantage that the wire can be bent to any shape required. However, there is also a word of warning to go with these remarks. Be careful, when you start to pull the wire off, that the straightening of it does not damage nearby components or wiring.

The scheme shown in figure 2 comes from a colleague of mine, and is one which I think will take a lot of beating. Lay the end of a length of solder across the nut and tap it gently with a hammer, the edge of the bullnosed pliers or other suitable implement, so that solder is forced down into the first thread.

This will hold the nut with remarkable firmness and, as with the tinned copper wire, the solder may be bent to any suitable shape. The removal of the solder is quite easy. As a slight variation of this, the nut and solder combination may be screwed up in a vice rather than hammered together.

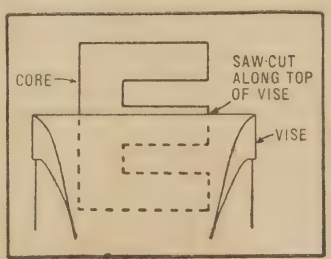


Fig. 3. Paring a transformer lamination to fit a new winding.

MATCH TECHNIQUE

Figure 3 shows a special nut-holding tool, which consists simply of a bolt with a length of tinned copper wire soldered to the head of it. In use the nut is held on the end of the bolt by about one turn, the wire bent to a suitable shape, and the nut forced against the end of the assembly bolt. This bolt is now turned with the driver until the thread is picked up, when the other bolt may usually be released by giving it a single turn.

In figure 4 we have another idea from a contributor but, as he omitted to sign his name, I am unable to give him full credit. Perhaps he didn't think it worth mentioning, or perhaps he is just plain bashful!

Anyway, the idea is to use an ordinary match and, as shown at (a), it may be formed into a very efficient midget screwdriver by simply pinching the end of it in a pair of pliers. By using the correct amount of "pinch," the blade of the "driver" can be made a force fit in the slot of the screw (b). As my correspondent points out, it is very handy for replacing screws in electric light switches. I must agree that this task can be a most irritating one and, if the idea is only useful for that, it will be justified.

However, at (c) is shown another solution to the nut problem, where the nut is forced on to the end of the match for a distance equal to one or two threads, leaving enough thread to be picked up by the bolt. If an angle is involved, the match may be given a green stick break as at (d).

ADHESIVE METHOD

Figure 5 shows a stunt which I use quite a lot myself. I usually have a jar of vaseline on the work bench, mainly for lubricating the various moving parts of dial assemblies, &c.

(Continued on Page 99)

Let's Buy An Argument

Despite the lack of horse, helmet and armour, I must perforce assume the role of a crusader. I must sally forth against those be-whiskered diehards and champion the cause of a whole rising generation of students. Which way DOES a current flow?

by W. N. Williams

EST you think the question of trifling importance, let me assure u that every student who ventures ong the electronic path, promptly ips over it and falls flat on his tellectual face.

He duly picks himself up, dusts mself off and ultimately comes to alise that he isn't a bunny after l. It's all the fault of a few silly d codgers who probably know bet- r but simply won't change their eas.

ERE'S THE POINT

To be more specific. I've come ross several instances lately of udents and readers who can't, for e life of them, reconcile the elec- on theory with the traditional efinition of current flow.

Let me say, here and now, "forget brother, you can't!"

I'm too young and innocent to now all the details of the story but is plain enough that our forebears had no real understanding of what electricity was. They could detect its presence, measure its intensity and even formulate laws governing its behavior. Sad to relate, however, they didn't know what it was and they didn't know which way it flowed.

It obviously had to go one way or the other so, by common consent, they agreed that electricity would henceforth be recognised as flowing from positive to negative. And they got away with it, too, because no one knew any better or, if they did, nobody would listen to them.

Thus it was that a statement to that effect went in to many text-books and here, I'm afraid to say, it has remained to this day. What's even more tragic, it's still being taught in some seats of learning, along with the electron theory. What strange bed-fellows they make?

Of course, it's also about time we stopped talking about the electron "theory" and substituted the electron "fact." Maybe our knowledge of the electron isn't complete (thank Heaven) but there isn't much doubt any more about its existence as an entity.

If any reader has evidence to the contrary, it had better be brought forward in a hurry, because a lot of nasty people are organising piles of atom-bombs on the general assumption that there is such an animal.

PLAIN FACTS

To get down to facts, the electron principle defines the atom as being composed of a nucleus around which is a constantly moving screen of electrons. No one has seen an electron but, by roundabout methods, scientists have established pretty definitely the electron structure of all the known elements and a few others into the bargain.

It is now known that the flow of an electric current is nothing more or less than a mass movement of electrons in a specific direction.

Pass a current through a wire and you have simply induced some of the electrons associated with the atoms of the metal to move towards one end, allowing other electrons to take their place.

And which way, I pray, does an electron move? Being negative in character, it is attracted to the positive pole. In other words, electrons move from negative to positive and, since electron movement is actually electric current, then current must also flow from negative to positive.

TRAP FOR OLD PLAYERS

Where the diehards get into real strife, of course, is in trying to explain the operation of a valve and the emission from a negative cathode to a positive plate.

Of necessity they have to explain all about electron acceleration and emission, space charge effects, the influence of external fields and the ultimate migratory effort on the part

of the electron across the wide open spaces. It is necessary to complete the circuit and show the electron passing down through the plate circuit of the valve to the positive terminal of the battery.

At this point, the student usually scratches his head and begins to ask, "Who's kidding who?"

Here's where character shows out. The honest lecturer or the honest textbook simply admits that the old geysers were wrong, that there is confusion as a result and that, to avoid error, the student should henceforth speak of electron flow rather than current flow, wherever direction is likely to be involved.

The diehard, on the other hand, grudgingly admits that electrons do travel from negative to positive, but that electron flow is accompanied by a current flow in the opposite direction, which puts Fleming and all the old school back in the running.

LET'S BE HONEST

What humbug is this? I'd be disappointed in the said gentlemen if they did not turn in their proverbial graves at the imputed mental dishonesty. What is this mysterious stuff that goes the other way? Are we to assume that, as the electrons dash in one direction, the atoms sidle off in the other? Or is there something else we don't know about?

The answer is emphatically "No." Electrons do all the flowing, charge all the condensers, create all the magnetic fields, do all the hard work. Let's be honest, then, and give them the credit for it.

The sooner this old positive-to-negative idea can be educated out of the curriculum, instead of into it, the better it will be for all concerned.

While on the general subject, it's about time there was a concerted crusade against those public and not-so-public speakers who persist in using electricity as a "perfect" example of a potent force which defies definition. It's applied to everything from psychology to politics.

WORDS WITHOUT SENSE

You know the theme . . . "It's like electricity . . . the globe remains cold and inanimate . . . the machine idle and useless until you press the switch. Instantly, the globe sheds its light; wheels begin to turn at the bidding of an intangible force that nobody understands. . . ."

It goes down big with the audience, whose belief in the "mystery" is confirmed for a future occasion. What a lot of hooey!

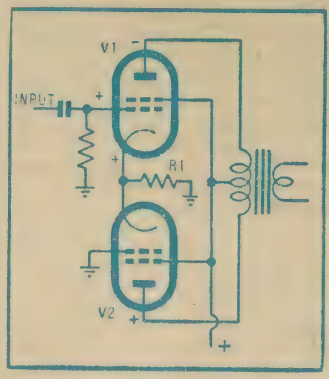
I've already pointed out that an electric current is purely and simply a mass movement of electrons in a specific direction. An electric potential is the accumulation of electrons at the terminal of a battery, a generator or some such device.

Electron pressure and movement can be measured, predicted and controlled as part of an exact science. There's no more mystery about it than the reactions in a chemist's lab. In fact, an understanding of "electricity" has had tremendous repercussions in this domain of bottles and test-tubes.

Nor does it bolster the "mystery" to suggest that we don't properly understand the electron. That's perfectly true, but the electron is common to all sciences. The riddle of the electron is inextricably woven with the riddle of life itself.

This, briefly, is the position. Next time you come across one of these eloquent but ill-informed orators, please take them aside and tell them what every old man should know!

Getting back to more mundane matters, I've been watching some of the circuits submitted for comment through the query service. Let me hasten to assure you that the foregoing sentence is not intended as a subtle advertisement for this part of our activities. The job of answering



Many will recognise this type of circuit. It has its limitations and it isn't a mystery.

hundreds of letters, even in brief, is having a slow but inevitable effect on all members of the staff.

Who knows but that some of the quips you read in these pages are not intentional at all, but have a definite psychological origin?

However, as I was saying, some of the circuits submitted for comment are interesting because they reflect a very poor understanding of what really goes on.

I'm not picking on the actual readers who have submitted the circuits, and I wouldn't dream of publishing their names, because we all make mistakes in the process of learning. The ones who should take notice are the older hands who propagate, in their own circle of friends, ideas which won't stand up even to a cursory examination.

PUSH-PULL DRIVE

A reader from Victoria became intrigued recently with the idea of cathode coupling. He ultimately derived the circuit of figure 1, presumably without knowing that it had already been the subject of much debate. As far as this reader is concerned, it was simply a matter of some genuine deduction and a genuine error in the process. The same excuse can hardly be tendered for those who still tell their friends that it is the best and simplest method of obtaining push-pull operation from a pair of valves.

The basic reasoning goes like this. Assume that a positive-going signal appears at the grid of V1. It increases the current through the valve and therefore the current through the cathode bias resistor R1. In other words, a positive-going signal appears at the cathode.

Now the cathode of V1 is joined to the cathode of V2, so that the same positive-going signal must appear at that point also. But the grid of V2 is tied to ground and a positive-going signal at its cathode has the same effect as a negative-going signal at the grid.

BUT IN PRACTICE...

Thus, the plate current of V2 falls as the plate current of V1 rises and a push-pull effect is obtained. By suitably adjusting R1, they maintain the drive can be balanced, but, in practice, R1 can simply be the normal common bias resistor.

That sounds all very nice and impressive until the other side of the story is told. In a true, balanced push-pull stage, the plate current excursions of V1 would be exactly equal and opposite to those of V2. There would be no instantaneous change in the total current through R1, and therefore no signal voltage across it.

In other words, the nearer V2 approaches to perfect balance with V1 the less signal there is available to drive it, which is an absurd situation.

What does, in fact, happen is that V2 gets some small amount of grid drive and we could facetiously invent a completely new audio term to suit the occasion. May we humbly present "Push-half-pull Output."

"Wait a minute," someone will say. "Have you ever tried it? Maybe it doesn't work in theory, but I've pulled the extra valve in and out and it does make a difference."

I won't get involved again in the theory versus practice argument, but I will suggest a couple of things that happen when the extra valve is pulled in and out of the socket. I freely admit that something does happen.

WHAT REALLY HAPPENS

With only V1 in position, it is operating into one quarter of the nominal P-P load, which would certainly be no more than half its optimum load for a single output valve. Furthermore, the interleaved push-pull output transformer would most likely be saturated by the unbalanced plate current, the effects combining to reduce both power output and bass response.

To make matters worse, R1 may provide insufficient bias for V1 alone so that the net result is a degree of performance falling well short of optimum single-ended conditions.

Now, then, you plug in V2 and the bias situation is immediately corrected. Then, quite apart from any drive on the grid, the plate current of V2 balances out the plate current of V1 in the transformer, corrects the saturation and also the bias and becomes the bass and the power output. Point number one is noted.

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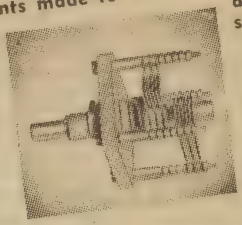

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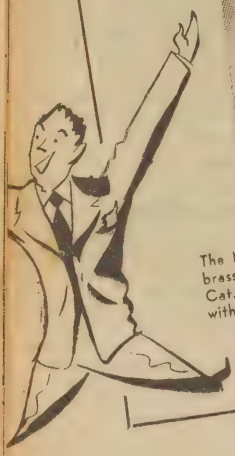

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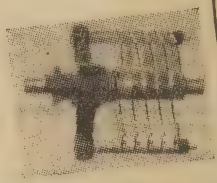

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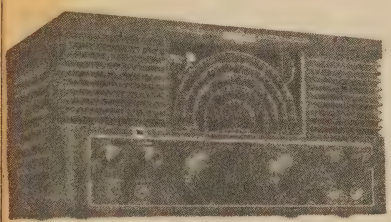

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Now take V2 out again and observe that R1 is an unbypassed cathode resistor. It can be expected to introduce a 6db drop in gain, due to negative feedback.

Plug in V2 and there will be a partial cancellation of signal voltage across R1, therefore a partial cancellation of the negative feedback and a rise in stage gain. In other words, part of the extra output you hear is due to added gain from V1, not added power from V2—and there's quite a difference between them.

The real conclusion to be reached from the aforesaid listening test is that a partial push-pull system is better than a bad single-end one, which isn't a very shattering conclusion.

LOW GAIN TRIODES

Let's add a few remarks for good measure. Without working it all out in detail, it's possible that low-gain, low-impedance power triodes would render the circuit unworkable, in that the insertion of the extra valve might well reduce rather than increase the power output.

If V1 happened to be a 2A3 working alone into half a 5000ohms transformer, its actual plate load would be 1250 ohms. Plugging in V2 and neglecting the drive, for a moment, would load its 800 ohm plate impedance across half the transformer, and it would obviously be reflected across the other half.

This would leave V1 working into a net plate load of 450 ohms and three-fifths of its residual power output would simply be absorbed by the plate resistance of V2. Boy, you wouldn't have much left!

Actually, the partial cathode drive on V2 would oblige it to contribute some power output, but, with an insensitive valve like the 2A3, it would need quite a few volts of drive before the power delivered from V2 exceeded the power absorbed by its plate circuit from V1.

I'd rate that as a neat little problem for anyone interested in analysing a useless circuit!

Of course, the grounded grid idea can be refined by using push-pull drivers with one grid grounded, selecting high Gm tubes, using common bias resistors for more than one stage, and, possibly, increasing the amount of cathode coupling.

Carried to its ultimate conclusion, the circuit ends up in the floating paraphase idea, illustrated by an old "Radiotronics" design we came across in the files.

This amplifier employs double push-pull as suggested, with high gain tubes, but the lower grid, instead of being earthed, is run back to a common point in the output grid circuit.

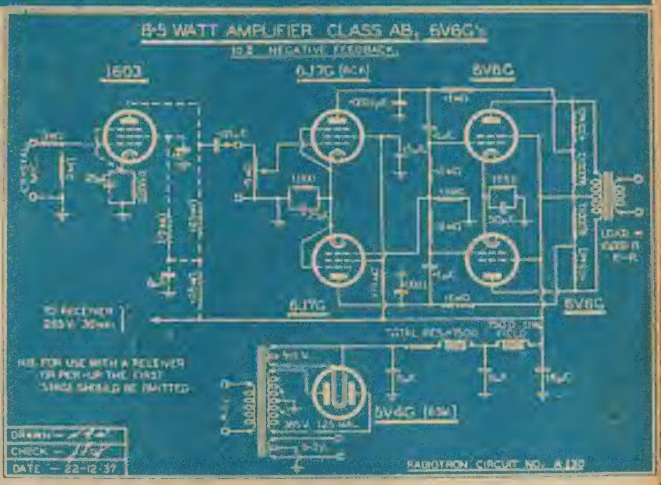
A positive signal on the upper 6J7-G is impressed as a negative signal on the upper 6V6-G. It is applied also as a negative signal to the lower 6J7-G and is then fed as a positive signal to the lower 6V6-G, giving push-pull action.

The circuit cannot achieve exact balance, because an equal and opposite swing on the output grids would infer zero potential at the point where the resistors meet—hence zero drive for the lower section.

In practice, the circuit automatically finds a condition of operation where a small unbalance component at the output grids, amplified by a pentode stage, is enough to drive the lower valve.

The scheme still isn't perfect, but it's a heck of a lot better than the one we started from. What's all this talk about "mystery?"

A TYPICAL PARAPHASE CIRCUIT



A typical amplifier circuit using the "floating paraphase" system of push-pull. It is the logical development from the primitive grounded grid idea.

AUDIO COUPLING

Still on the subject of amplifiers, I was confronted the other day with a letter from someone who wanted to build a "really good" amplifier system. Much of the emphasis lay on proper coupling of the speaker and, sparing no expense, our friend proposed to put in a 500 ohm link with appropriate transformers fore and aft. This for a purely domestic amplifier.

If ever a good idea was abused, it's this 500 ohm line business. And yet it has such a simple and logical basis.

When audio signals have to be run over distances of more than a foot or so, it is necessary to consider the possible effects of the long lead on the signal.

For example, the volume control leads in most receivers have to be run in shielded wire to prevent them picking up hum from surrounding AC fields. And they are particularly prone to pick up hum because the net impedance of the grid circuit to earth may be around the quarter to half-meg mark.

LEAD CAPACITANCE

Inevitably, there is a good deal of capacitance between the inner conductor of a shielded wire and the earthed braiding, so that every extra foot of shielded wire that is used is equivalent to adding another condenser between grid and earth ranging as high as 600 pf. And it doesn't take many feet of wire and many such condensers to play havoc with the treble response.

There are many occasions, however, particularly in studio set-ups, where audio may have to be run between points hundreds of feet apart. This would entail prohibitive treble loss and a terrific outlay for shielded cable.

To avoid these difficulties, engineers have adopted the practice of lowering the impedance of the audio signal line before it starts on its long run. It can be done quite conveniently by using a step-down transformer, a cathode-follower stage, or, more simply, a resistance pad arrangement.

By dropping the circuit impedance to a few hundred ohms, it becomes possible to do without shielding altogether in many cases, since a low impedance line is much less sensitive to hum pickup. If shielding is used as a precautionary measure, the effect of the shunt capacitance across the low impedance line is very slight.

LINE IMPEDANCE

Now it doesn't matter very much whether the impedance is reduced to 100 ohms or 1000 ohms, or to any figure between or around these two. Purely as a matter of convenience, engineers have standardised for most purposes on five or six hundred ohms.

For studio work, this process of standardisation means that microphones and pickups provided with in-built "line" transformers can be fed straight into amplifiers with "line" input terminals. Consoles can couple to patching panels, telephone lines and so on, at levels which are also subject to recognised limits.

Yes, the 500 ohm convention is a very handy one.

At the other end of the scale, our public address man may want to

(Continued on Page 90)

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PART 24—ELECTROMAGNETIC DEFLECTION

For reasons which are not difficult to understand, nearly all large picture tubes are intended for use with magnetic deflection and focus. This article introduces the student to the techniques involved, as distinct from the more familiar electrostatic deflection methods.

IT was pointed out in the last article that, as CR tube size is increased, the necessary deflection voltages become of such an order that they cannot be obtained conveniently from wide-band voltage amplifiers. Common practice, therefore, is to provide for magnetic deflection of tubes having a screen diameter larger than about six inches.

Magnetic deflection is not without its own parellel problems, but they have proved capable of a more ready solution.

The general construction of both types of tube was explained in an early article in this series, and it will be remembered that two essential functions are involved, one of focusing and the other of deflecting the electron beam.

The principles of electrostatic focus and deflection are sufficiently well understood as not to require further discussion at this stage. It is a matter of providing the requisite DC potential on the focusing electrode and the requisite peak AC signal voltages on the respective pairs of deflecting plates.

Some tubes have combined electrostatic focus with electromagnetic deflection, and there are even examples of mixed or optional deflection methods. Such tubes are in the minority, however, and most types used in commercial television receivers provide for fully magnetic control of the beam. The high voltage "gun" is still necessary, of course, to produce the electron beam in the first instance.

In its simplest form, a magnetic focusing coil is simply a coil of wire slipped over the neck of the tube at an appropriate distance from the electron "gun," as specified by the tube manufacturers.

FOCUSING COIL

In practice, the focusing coil is more likely to take the form of figure 1, where the winding is contained inside a magnetic cover made from specially-shaped soft-iron sheet or from layers of iron wire. The purpose of this additional element is to confine the focusing field and to concentrate the lines of force across a narrow gap.

As might be imagined, considerable significance attaches to the dimensions of the gap, to ensure the most effective focusing action. However, there is no need to examine component design in greater detail at this stage.

The dotted lines in figure 1 give a simple picture of the magnetic lines of force which would exist within the tube.

By way of a brief interlude, it may be as well to remind readers of Fleming's classic left-hand rule

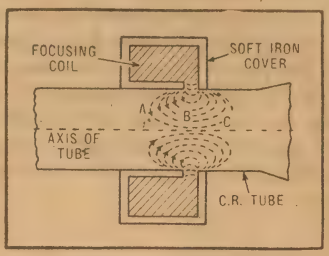


Figure 1: Illustrating the focusing action of a magnetic field in a CR tube.

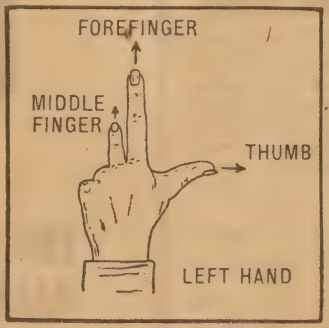


Figure 2: Fleming's well known left-hand rule, which correlates magnetic flux, current and the force exerted on a conductor.

which governs the motion imparted to a conductor which carries current through a magnetic field.

As indicated in figure 2, the thumb points to the right, the forefinger upward and the middle finger forward.

If the ForeFinger represents the direction of the Flux, and the mIddle fInger the direction of the current (I), then the thuMb gives the direction of Motion of the conductor. Note the key relationship between the capital letters.

Using this rule, a knowledge of any two of the quantities will give the third. If either the direction of the field or the current is reversed, the motion will likewise be reversed and so on. If both field and current are reversed, then motion will be unchanged.

Note also that the direction of current flow, as envisaged by the Fleming rule, is in the traditional electrical sense from positive to negative. This is just the reverse of the actual movement of electrons from negative to positive.

Finally, in the absence of an actual conductor, the force is evident on the electrons themselves as they cut the lines of magnetic flux.

All this should serve merely as a reminder of basic electrical laws. Readers who intend to pursue further the design of deflection coils, &c. would do well to revise some of this early material.

Reverting to figure 1, it will be seen that electrons passing along the axis of the tube will not cut the lines of force but will merely travel parallel with them. The path of the electrons will not be affected and as a result, they will go on to strike the centre of the fluorescent screen.

On the other hand, electrons which tend to diverge from the centre line may encounter the magnetic field, for example, at "A." Here the lines of force are at an angle with the axis of the tube and the direction of electron motion.

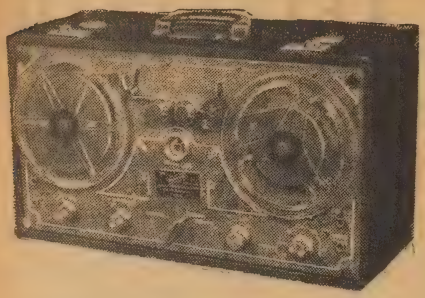
ELECTRON MOVEMENT

As a result, the electrons are pushed sideways in a way that would lift them, as it were, from the surface of the paper. Under the influence of the axial field they take on a forward, spiral action, which ultimately brings them into the region "B," where the lines of force are substantially parallel to the axis.

Here there is an immediate interaction between the transverse component of the electron movement and the axial field, producing a component which tends to pull the electrons closer to the tube axis.

When the electrons ultimately reach region "C," they are closer to the axis of the tube and are therefore subject to a much weaker traverse component in the magnetic lines of force. In other words, the net effect of the field has been to converge the outer electrons as they progress toward the screen.

For exact focusing, it is necessary to control accurately the strength of the magnetic field and this naturally depends on the number of turns in the focusing coil and the amount of current passing through it. The focusing effect is



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controlled most conveniently by varying the current.

There is obviously much room for variation here but common practice is to design the coil so that it requires from 20 to 50 milliamps of current to achieve correct focusing. The coil is then connected in series with portion of the power supply to the receiver, in much the same way as the back-bias circuit in a conventional set.

By a simple potentiometer control, the focus can be varied as necessary (figure 3).

To deflect the beam after focusing, the deflection coils must be arranged so that they produce a transverse field—that is, a field which is at right angles to the axis of the tube and to the electron beam.

In their simplest form, deflection coils can take the form of flat discs, as in figure 4a, the two pairs being arranged at right angles to produce the necessary vertical and horizontal movement.

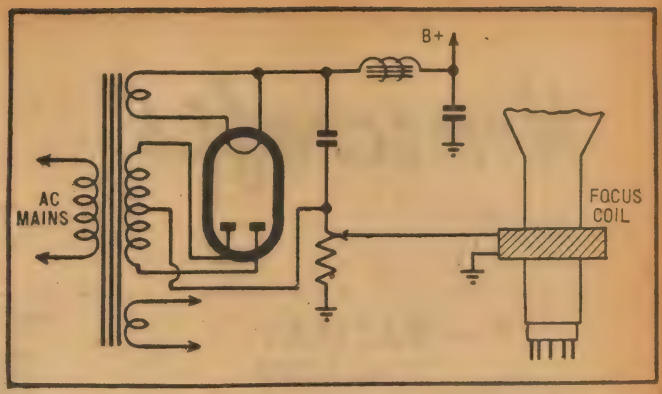


Figure 3: A common method of focusing a CR tube is to pass portion of the HT current through the focusing coil.

LINEAR FIELDS

The magnetic fields across the neck of the tube are approximately linear and it follows that electrons passing along the tube will be deflected at right angles to the lines of force, depending on the direction of the magnetic field at the particular instant.

It can be shown mathematically, that the amount of beam deflection is proportional (1) to the strength of the deflecting field (2) to the width of the field traversed by the beam and (3) to the distance between the point of deflection and the fluorescent screen. Finally, beam deflection is inversely proportional to the square root of the gun voltage.

The tendency to use large-screen, high-definition tubes complicates problems of deflection because (1) the flying spot has to cover a larger screen area (2) short tubes involve even sharper deflection angles and (3) high gun voltages make the beam harder to deflect.

In the light of the above it is necessary to design the deflection circuits so that they will be as efficient as possible and have the maximum influence on the electron beam. The simple coils suggested by figure 4 seldom occur in practice, the more usual procedure being to wind the coils in a rectangular pattern and form them around the neck of the tube (figure 5).

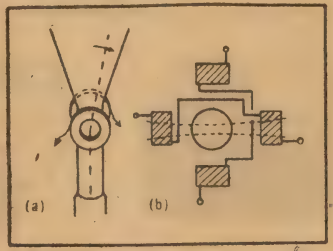


Figure 4: Illustrating (a) the simplest deflecting coils and (b) the arrangement of four coils around the neck of the CR tube.

In addition, it is common practice to provide an iron yoke, to assist further the action of the coils.

In all this, care is necessary to maintain a uniform density of magnetic flux across the neck of the tube. If the field is not perfectly uniform—and this is difficult to achieve in practice—there is a tendency for the beam to undergo a change of focus as it moves across the screen. This effect, which finds a parallel in the electrostatic case, leads in practice to a possible loss of definition near the edges of the picture.

A similar loss of definition can be traced to various other peculiarities in CR tube behavior, but consideration of these can best be held over for a later, specialised article.

So much then for the physical arrangement of coils and magnets. In order now to induce a saw-tooth motion to the scanning spot, it is necessary to produce a saw-tooth current through the deflecting coils. This raises a special problem.

With electrostatic deflection it is merely necessary to apply to the deflecting plates the saw-tooth voltage wave-forms which have already been generated by the scanning circuits.

When using electromagnetic deflection, however, it is not satisfactory merely to apply the saw-tooth voltage across the coils, because the current through the coils takes on a different wave-form. The matter is best understood by reference to figure 6.

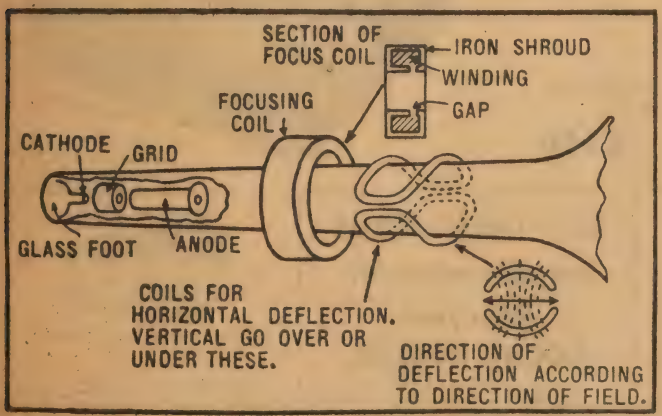


Figure 5: The complete beam forming, focusing and deflecting system in a typical picture tube. Deflecting and focus coils are commonly contained in an iron yoke.

RESISTANCE CIRCUIT

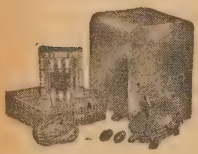
The simplest case involves a purely resistive circuit in which the current through the circuit follows exactly the voltage which is impressed across it (6a).

With a purely inductive circuit however, as in 6b, the current through the coil lags the voltage applied across it. In order to obtain a saw-tooth current wave-form through the coil, it is necessary to apply across it a voltage of rectangular wave-form.

In other words, if a voltage is suddenly impressed across the coil (as at commencement of 6b) the current through the coil begins to build up at a rate which is controlled partially by external circuit conditions. In fact, there exists a resistive/inductive time constant which is directly comparable with resistive/capacitive time constants already explained.

Homecrafts

BATTERY CHARGER KITS

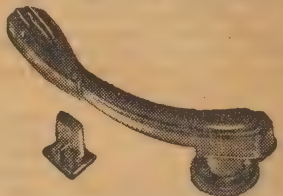


6-volt, 4-amp battery charger kit set. Grey metal case rectifier, transformer, 2 terminals and hook-up wire. As illustrated.

Price £5/5/-

12-volt, 2-amp. Kit, 5/- extra.

PICK-UP BARGAIN



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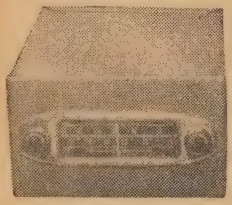

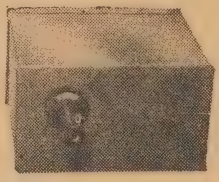

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When the rectangular wave-form drops again to the zero or reference level, the current through the coil reverses its direction to produce the downward stroke of the saw-tooth pattern.

In actual practice, the deflecting coils and their associated circuitry are not purely inductive but contain a large resistive component. As a result, the voltage wave-form which must be applied to the deflecting circuit as a whole is more likely to resemble the compromise form of 6c.

Referred back to the scanning wave generator, it involves fundamentally the inclusion of a resistor in series with the basic timing condenser, as illustrated in figure 6. It is usual to provide for some variation in this resistor to achieve optimum linearity.

The effect of the resistor may be traced as follows: During the initial charging cycle, C charges through the large resistor R1 and the much smaller series resistor R2. Actually, R2 has little effect on the charging cycle.

When the discharge device operates, however, resistor R2 is found to have a value which is very much larger than the resistance of the discharge device.

As a result, there is an immediate drop in potential at the sweep output terminal, resistor R2 and the discharge device providing a voltage divider effect for the initial potential across C.

Thereafter, C discharges to produce the oblique return to the zero line, as indicated by figure 6c.

When the discharge circuit opens, R1 and R2 constitute a voltage divider across the HT supply and there is an immediate positive potential at the sweep output terminal. Thereafter C begins to charge slowly to the potential which will again cause the discharge device to operate.

In a complete timing circuit, the requirements envisaged by figure 7 would have to be correlated with other circuitry to ensure linearity and the final R/C circuit may grow into a rather mysterious collection of components. However, the basic principles outlined could be traced out.

Before leaving the subject of magnetic deflection, it will be necessary to consider in the next article some of the special factors which govern the design of the sweep amplifier feeding the deflecting coils.

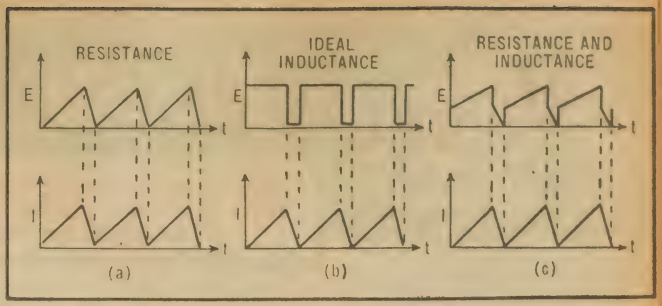

Figure 6: Illustrating the relationship between the voltage across resistive and inductive circuits and the current flowing through them.

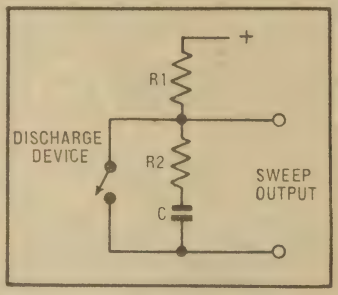

Figure 7.— The addition of resistor R2 in series with C modifies the output of the timing circuit in accordance with the requirements of figure 6c.

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ELECTRONIC A & R EQUIPMENT

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Z 975-6	15	50	320	500
Z 973-9	20	80	370	500
Z 1012-1	20	100	430	1000
Z 967-1	20	150	200	1000
Z 956-1	20	200	160	1000
Z 962-1	25/5	20/200	100	1000
Z 1011-1	15	250	160	1000
Z 983-1	20/5	30/300	90	1000
Z 986-1	10	300	60	1000

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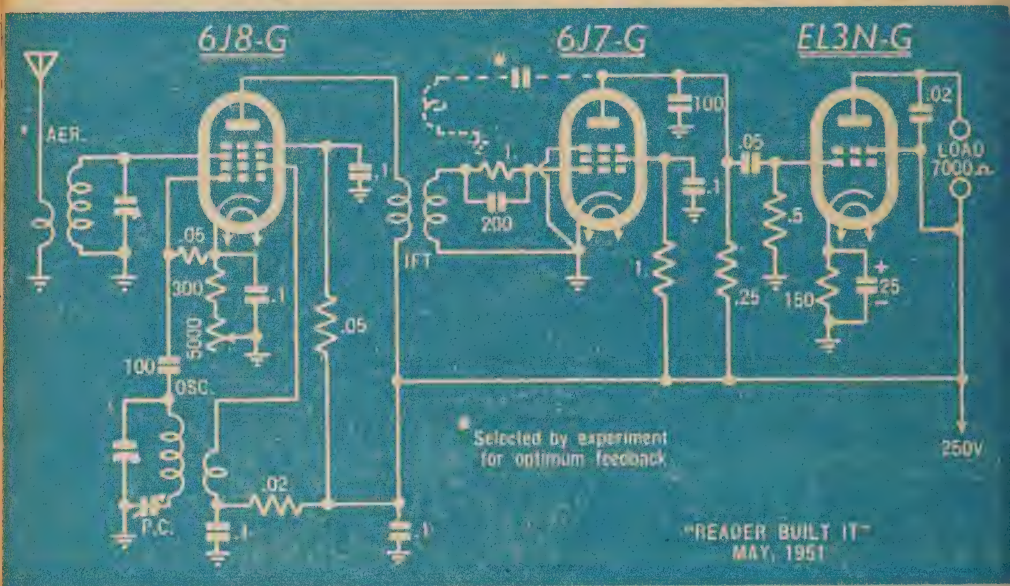
A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

A THREE VALVE SUPERHET WITH REGENERATION



Here is one way in which you can "pep-up" a regenerative detector feeding a high-gain output valve. By placing a converter stage ahead of the detector and producing constant intermediate frequency, the entire tuning range of the set can be covered without adjusting regeneration.

OUR contributor, Mr. D. Allen, of Lower Snug, Tasmania, is quite keen about this set. Whilst not exactly new, there are a few points which the small-set experimenter may find worth considering. First, here is the obvious convenience of single-control tuning. After the regeneration is set initially, no readjustment is necessary when tuning around the dial.

Second, the addition of the converter valve places another tuned circuit between the detector and the aerial. This, with the inherent selectivity of the 455 kc intermediate frequency transformer, increased even further by regeneration, produces a worthwhile increase in the overall selectivity of a simple regenerative detector and audio combination. Furthermore, there is an increase of gain obtained from the converter valve.

The usual limiting resistor is employed in the converter cathode to ensure minimum operating bias for the valve when the 5000 ohm control is advanced full-on. The resistor value will be 300 ohms for the 6J8-G and similar types, and 200 ohms for the ECH34, ECH35 types. The X61M should have 300 ohms when operating 100 volts screen and 200 ohms for the 85 volt screen operation.

ONLY ONE IF

One IF transformer only is required. Either the No. 1 or the No. 2 can be used but, if you have the choice, select the No. 1. Our contributor happened to use an older air-cored type with compression-type trimmers.

The modification is quite simple. Slip the innards from the can and locate the winding which connects to the G and F pins on the base. On the side of this winding away from the other winding jumble, wind about 80 turns of light-gauge enamelled wire. Our contributor used 32 SWG. One lead is earthed to the F pin and the other is brought out either through the can or through the base for connection to the plate of the 6J7-G through the feedback capacitor.

When the set is in operation and the windings of the IF transformer peaked, select a value of feedback capacitor which places the detector just below the point of oscillation. Our contributor used a value of 200 pf. Some variation of this value will no doubt be found with individual sets. If you fail to obtain regeneration, reverse the connections to the feedback winding.

Of course, there are other ways of arranging for regeneration in the detector circuit, but this is one way in which to go about it.

TEST running in regular freight service during the past eighteen months of America's first gas-turbine electric locomotive proves the efficiency of this type of prime mover in railroad work, and ten additional locomotives of this type are now under order.

TRADE REVIEWS AND RELEASES

TECHNICAL BOOK REVIEW

THE SLIDE RULE IN THEORY AND PRACTICE by G. P. Rawlings, O.B.E., M.A., published in London (1950) by Percival Marshall and Co. Ltd. Hard cover, 127 pages. Australian price 16/- plus 4d postage. Leading booksellers have small stocks at present.

Treatment of a subject, which is difficult for students who may have forgotten school mathematics, is carried out in a lucid style. The book will be of great assistance to slide rule users both raw beginners and those already able to make limited use of the instrument.

Beginning with examples of the simplest calculation with a slide rule, the book goes on to deal with such subjects as order of accuracy, squares and square roots, cubes and cube roots, finding other powers and roots, gauge marks, the trigonometrical scales &c.

A wide selection of graded examples is included some being fully worked to illustrate the methods detailed in the text. This is a valuable feature of the book since the nature of the subject demands a fair amount of practical experience on the part of the student before proficiency can be attained.

To illustrate the text a number of drawings are included together with photographs of the slide rule at various settings.

★ ★ ★

RADIO CONTROL

MOST recent addition to the Gernsback Library, No. 43, is titled *Model Control By Radio*. Written by Edward L. Safford jun., the book comprises 112 pages of text and illustrations and will sell in Australia for approximately 13/6 plus 6d postage.

Although some knowledge of radio must be assumed, the book begins on quite an elementary plane with an explanation of control systems and possible pulses arrangements. It then explains the principles of light, wired and radio control, radio receivers and pulse de-coding systems.

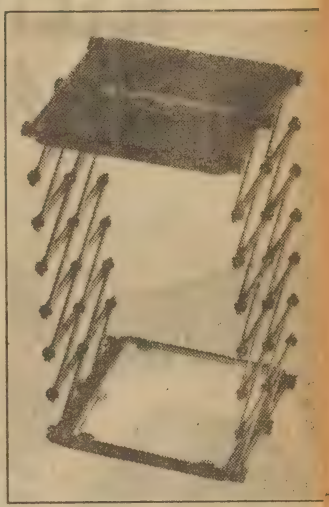
The second half of the book is almost entirely devoted to the constructional aspect—how to make things and get results.

★ ★ ★

● Angus & Robertson, of 89 Castlereagh St., Sydney, has recently published a catalogue listing their comprehensive stock of technical books. The catalogue indicates the title, author, size, edition number and price, together with a brief explanation of the text. It would be invaluable to lecturers and students of technical subjects.

COLLAPSIBLE TRENCH PERISCOPE

Messrs Surplus Stores, of 512 Elizabeth St., Melbourne are offering for sale collapsible pocket periscopes originally manufactured for use during the last war.



THE periscope as illustrated consists of two good quality metal-backed mirrors held face to face by a pair of pantograph type arms, which will open to a total distance of about 17 inches.

It is suggested that the periscopes can be used in crowds for viewing sports meetings, processions and so on. Quite apart in its original form, the periscope can be readily dismantled to yield two excellent metal-backed mirrors, measuring approximately 4½ by 2½ inches. The arms can be used as pantograph-type mounts for a telephone, microphone, inspection light or such like.

Retail price for the periscope is 16/6.

TECNICO HAVE M.S.S. RECORDING DISCS

WE have received some M.S.S. direct recording discs from the Australian distributor—Tecnico Ltd., of 53 Carrington St., Marrickville—with which we have made exceptionally quiet, bright, hard-wearing records. They are made in England by M.S.S. Recording Co. Ltd., makers of a wide range of high-grade, professional equipment.

CONSTRUCTION

The discs have cores of the highest grade aluminium obtainable and are coated with a black cellulose lacquer which has been designed to permit efficient cutting over the very wide range of ambient temperatures of from 0 deg. C. to 60 deg. C.

PERFORMANCE

When cut with a well-made sapphire cutter the background noise is more than 50 db below the output from a groove modulated with 1000 cps tone at a lateral velocity of 2cm/sec., measured through the weighting network approved by the CCI for objective noise measurements on international music circuits. Resistance to wear of the discs is extremely good and a frequency range extending to well above 10 Kc is easily recorded and reproduced.

The "ageing" properties of the discs are excellent and they may be stored either blank or recorded for an indefinite period without deterioration.

USE

No treatment of the disc, such as hardening or oiling, either before or after cutting, is recommended.

When replaying from M.S.S. discs a modern lightweight reproducer with an accurately ground sapphire stylus is desirable. If the weight of the pickup on the needle point exceeds 2½oz (70.9 gms.) a trailing needle should be used.

OTHER ITEMS OF INTEREST

● Messres R. W. Steane advise that they will soon have available stocks of dual-wave brackets to suit the 1R5 battery converter. Quantity release of this bracket had been held up for some time by pressure on other lines.

● The high-slope RF pentode, which was being marketed by the A. W. Valve Company as type Z77/6AM6 will revert to its English type number, namely Z77. Although the types are similar in most respects, slight differences do exist in the characteristics which warrant a distinction between them.

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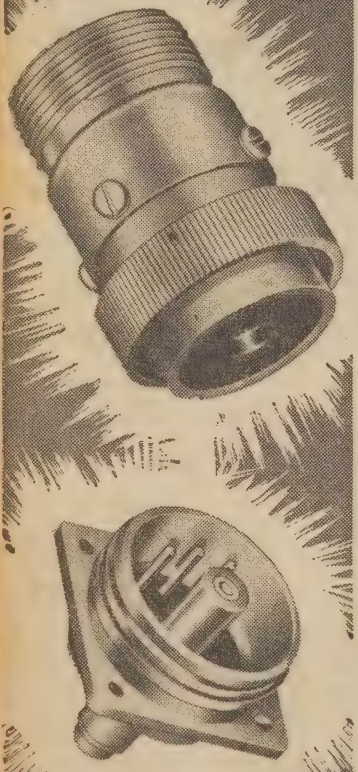

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GET TO KNOW YOUR DEVELOPERS

DEVELOPMENT TABLE FOR PLATES AND FILMS

PLATES	H.&D.	DISH *Ilford M.Q. Ilford Pyro Soda and Certinal Developer*			TANK *Ilford M.Q. Ilford Pyro Soda and Certinal Developer*		
		55°F.	65°F.	75°F.	55°F.	65°F.	75°F.
		min.	min.	min.	min.	min.	min.
H.P.2	5000	4	3	2	8	6	4
Hypersensitive Panchromatic ...	3500	6½	4½	3½	14	9	6½
Trichrome	3500	7½	5	3½	15	10	7
F.P.1	2500	3	2	1½	6	4	3
Double-X-Press...	2000	7½	5	3½	15	10	6½

Fig. 1. This is portion of a time and temperature table reproduced from the Ilford Formula Book. Note that two concentrations of developer are given, one for dish, the other for tank.

In this article we discuss published data on developers, cover what should be regarded as an acceptable minimum and explain how this may be expanded to suit your own requirements, including the handling of unknown films.

IN an earlier article we stressed the need for adequate developer information, recommending that the beginner use a product which listed developing times over a range of temperatures, as well as for the particular film being used.

For the beginner in particular this is still sound advice, and in many cases the advanced worker is also quite content to work on this basis.

GETTING THE "GEN"

On the other hand there are plenty of cases where, for various reasons, this is not convenient. Very often there is available a developer which suits in every respect but with no information on how it should be used with a particular film. The question then arises as to whether this information can be obtained by experiment or, if some information is already available, whether it can be converted to suit the new conditions.

Providing a certain minimum of information is available, it is usually possible to extend this by experiment, but we would once again stress the inadvisability of using any developer which is supplied without this bare minimum. The makers may claim that it is the developer to end all developers. They may be right, but if they are unable to supply relatively simple data on the effect of temperature, is it likely that they are able to assess its value in other respects?

Of course, it is often claimed that it is impossible to lay down hard and fast rules for the development of any film, since there are so many variable factors involved, such as choice of paper, type of enlarger, type of subject usually handled, &c.

In the main this is true, and it really means that even when all possible information is given, some experiment and slight modifications may be necessary to suit the individual case.

But there is a vast difference between an experiment conducted on a basis of sound information and one conducted in the face of unknown variables. The former will lead to progress, the latter to chaos.

TEMPERATURES

Although the fact is often ignored, it must generally be conceded that the amateur is forced to work at varying temperatures. There are not many advanced workers who are equipped to work at a constant temperature. Thus it is essential to know exactly what effect these variations will have on a particular developer. This may be regarded as the basic information which must be known before any experiments can be conducted and is the minimum which it is reasonable to expect that the makers supply.

As well as those marketed by independent organisations, and which must be regarded as quite satisfactory, there are a number of popular developers obtainable from the film manufacturers. A great deal of information is not usually given with the developer, but it is generally published in data booklets, available either gratis or at a small charge.

The manner of presentation of this data is illustrated by reproductions from two well-known makers' booklets. In the case of the Ilford manual this takes the form of a simple table, wherein are listed the various types of films produced by the maker (only a small section of the table is reproduced), together with their development times at three different temperatures.

The centre temperature (65 degrees F) is usually regarded as about optimum, while the other two values represent those extremes beyond which it is not generally advisable to work unless special precautions are taken. It may seem that the use of only three temperatures leaves rather large gaps, and it is true that many tables work with five-degree steps. However, it is not difficult to interpolate for those values which are not shown, at least with sufficient accuracy for all practical purposes.

The other reproduction is from the Kodak Data Book, and shows a graph with time of development plotted on the horizontal axis and temperature plotted on the vertical axis. Each of the sloping lines represents a particular developer, and it is immediately apparent that the effect of temperature varies considerably from one to another, the difference in slope between "D" and "E" being most marked.

However, the important point is that these are developer characteristics and are not necessarily associated with any particular film.

In other words, the slope of the line is governed by the developer, and its position is governed by the film.

USING THE SLOPE

Thus the slope may be regarded as constant for that developer, it merely being moved to the right or left as required for any particular film. In cases where the correct time is given for a film, usually at 68 degrees F, it is then only necessary to draw a new line, parallel to the old one and intersecting the known time line at 68 degrees.

From the above it will be seen that the graphic method of portraying time temperature effects has a number of advantages. It shows the

by Philip Watson

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Carlyle & Co. Ltd., 915 Hay St., Perth, B9371.

L. S. Wise & Co., 14 Pirie St., Adelaide. C818.

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Swan Electrical Co. Ltd., Wellington, Christchurch, Auckland, Dunedin.
Giles & Elliott Ltd., Wellington.

BYER INDUSTRIES PTY. LTD.

8 Dorcas Street, Sth. Melbourne, Vic.

developer characteristics at a glance, it renders easy the determination of intermediate values, and simplifies the adjustment for various films.

When information is available only in table form, there is no reason why it should not be transferred to a graph if required. The only thing required, apart from ordinary drawing materials, is some log-linear graph paper, and this may be obtained from most stationary suppliers.

It is likely that the graph paper you buy will not have any divisions between the 10 and 20 marks, but these are very desirable, as a lot of information falls in this region. Since these divisions are spaced according to a logarithmic law, it may at first appear that a lot of calculation is called for.

Fortunately there is a simple method available, and as we had to use it on our own graph paper, the method is illustrated in figure 3.

Draw a line from the 10 to the 20 division mark as shown on the graph, between points "X" and "Y." Now draw lines parallel to this, intersecting the time divisions 6, 7, 8 and 9, and these will intersect the base line at the points 12, 14, 16 and 18.

MARKING VALUES

The method of marking the time and temperature values is evident from the illustrations, but a few words about plotting the graph itself may be in order. It frequently happens that the times quoted in a table are taken to the nearest quarter of a minute, and when these are transferred to a graph they may not lay exactly along a straight line.

Where five or six temperature values are given there should be enough points to indicate the angle of slope, allowing one or two points to fall slightly to each side. If figures are given for several films, an additional check is possible by plotting several graphs, all of which should be very close to parallel. This method will produce an accurate graph even when there are only two or three temperature points available.

Once a graph is available, experiments may be considered. Let us suppose that you have been using a certain type of film, say type "A," and that you have been processing it in the same maker's developer and according to his instructions. But your prints, made on a medium grade of paper, consistently show a lack of contrast. It is obvious then that the development time needs to be increased and, if consistent results are to be obtained, the increase must be proportional at all temperatures.

A NEW GRAPH

To do this it is only necessary to draw a new graph parallel to the existing one, and located to the right by the required increase at any one temperature. The corrected time for any other temperature is then immediately available without further calculation.

However, it is when one has to

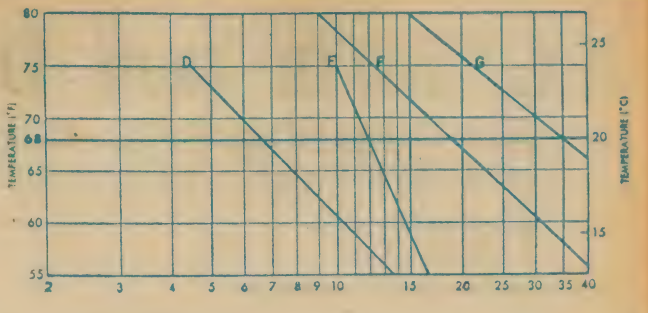

Fig. 2. This graph is reproduced from the Kodak Data Book. Each line represents a different developer, and the varying effect of temperature is readily apparent.

deal with a completely unknown emulsion that the developer graph is of most value. Suppose that, as well as films of type "A," you wish to process films of type "B," still using the developer for type "A," since it appears to be quite satisfactory, and is already on hand.

TRIAL DEVELOPMENT

It will be necessary to expose and process a roll of film "B" on a purely experimental basis, and while it is not likely to be completely spoilt, it is not advisable to include any subjects of real value on it. What is required is a fair proportion of your average type of shot, and preferably including some subjects which have already been handled successfully on film "A." It is also a good idea to include a few subjects having extremes of high and low contrast.

Before deciding on an experimental development time, obtain as much information as possible about development times for films in the same general class. This is by no means conclusive, but it does provide a starting point. Draw a new graph line, preferably in penc representing the experimental tim and then process the film accor ing to it.

When prints are made from the negatives, using your usual metho and grade of paper, it will be im mediately obvious whether your est mated development time was any where near the mark. If the erro appears great it may be desirab to draw a new graph line on th basis of the amount of error, an then expose and process a secon experimental roll before using th film type for regular work.

FURTHER CHECKS

However, it is not likely that th error will be as great as this, an it will usually be possible to est mate the required correction, if any with reasonable accuracy. This wi enable the film to be used witho further experiment, although, as sub sequent rolls are handled, it ma appear that further slight modifica tions are desirable if the very fines results are to be obtained.

Figure 3 is a graph prepared i

(Continued on Page 104)

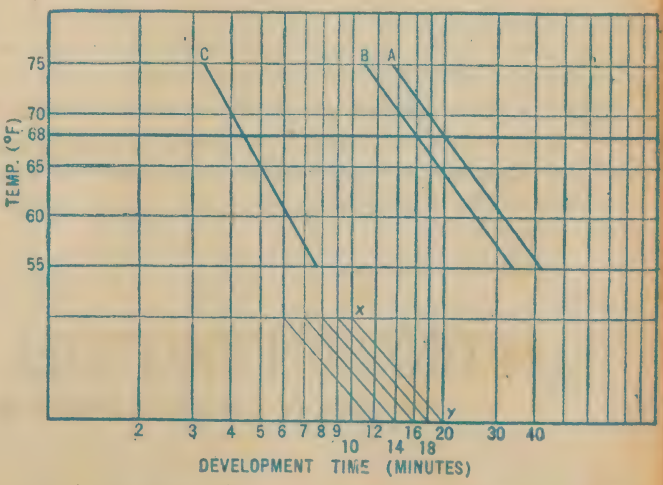

Fig. 3. A graph prepared in our own drawing office from information included in the Ilford and Kodak data books.

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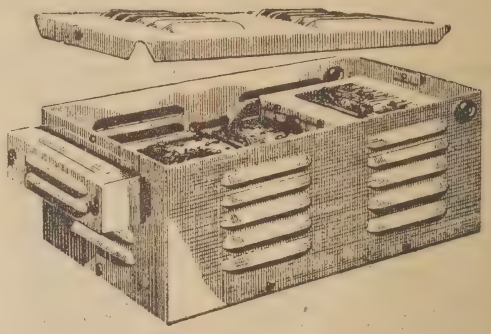

The Valradio invertor can be supplied with specially calibrated vibrators for any frequency within the range of 40 to 75 c/s. These invertors are suitable for most purposes where an AC supply is essential. The frequency stability is exceptionally good and may be used for driving tape recorders, synchronous gramophone motors and other devices requiring accurate frequency AC supply.

The standard DC/AC invertor is not suitable for operating gas discharge devices such as fluorescent and neon tubing, special models, however, can be supplied for this purpose. These heavy duty DC/AC non-rotary invertors are available in sizes to meet the widest possible range of DC input and AC output.

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HAND OPERATED VACUUM CLEANER

A blower motor from an ex-service radar transmitter is the basis of this hand vacuum cleaner. It is a useful supplement to a regular vacuum cleaner for dusting, since it can be used in confined spaces or it may save an expensive cleaner if you have only a few carpets in your home. The total cost should be less than £2.

MOST of the motors are so arranged that they can be operated from either 12 or 24 volts d-c simply by changing over a pair of wires. Experience has shown that they will operate with equal efficiency on 50 cycles a-c provided the supply voltage is approximately doubled. We will have more to say about this later in the article.

The complete unit is held in the hand, the dust-bag being of moderate size. Brushes and other fitments can be slipped on the inlet tube for dusting chairs, curtains, and so on. The floor can be done by adding an extension tube, and the vacuum created is ample for removing grit, dust, &c., from carpets and floors.

BLOWER MOTOR

The motor and blower are shown in Fig. 1, and the type obtained should be that with a fairly large blower fan in a circular metal casing. The screws holding the motor to the latter should be removed and the blower casing slipped off. It has a central hole over which the inlet tube is fixed, as illustrated.

Fig. 2 shows how the inlet tube is made. If a suitable length of large-diameter brass or copper tubing is to hand, this could be used. Otherwise take a piece of tinplate 4in by 2½in bend it carefully around a piece of wood or other circular object to obtain the tubular shape and solder the overlapping edge.

The large washer illustrated is then cut from tin or other metal which can be soldered easily; it should be a push fit over the tube and is soldered in position.

Four countersunk bolts, heads on the inside, hold the inlet tube to the blower casing. These bolts pass through holes drilled in the casing and the tin washer and should have spring washers under the nuts so that

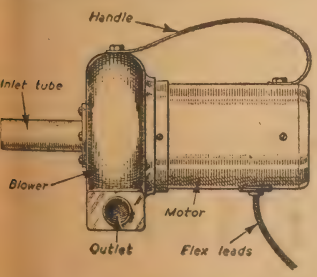
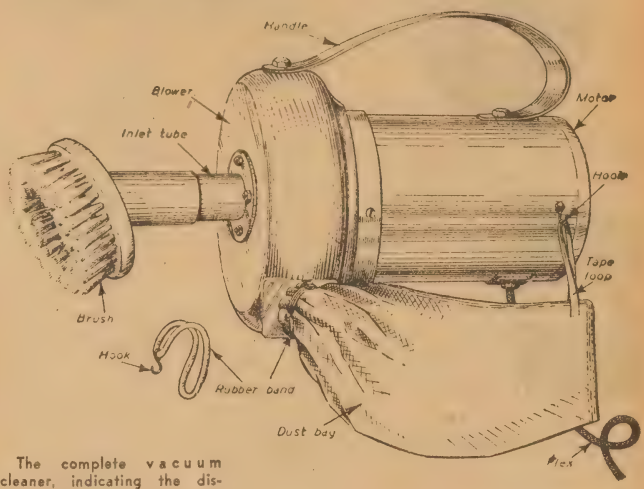


Fig. 1. The completed unit minus the dust bag and brush.



The complete vacuum cleaner, indicating the disposition of the various parts.

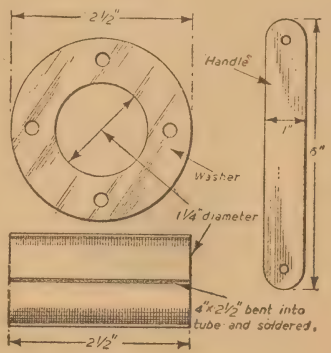


Fig. 2. Details of handle and inlet tube.

vibration will not make them work loose.

The handle is made as shown in Fig. 2 and curved to the shape depicted in Fig. 1. Sheet brass of 12 or 14 s.w.g. is suitable, or two thicknesses of thinner material can be used.

A countersunk bolt secures the front of the handle to the blower casing. The blower should then be replaced on the motor and the retaining bolts put in, after which the rear end of the handle is secured by a bolt at the end of the motor.

Each of the dusting tools is made with a tube which is a push fit over the inlet tube described. These tubes, which will require to be 1¼in INSIDE if the dimensions given in Fig. 2 are followed, are made from tin, curved and soldered as mentioned.

The brushes are of ordinary type, obtained from a hardware shop. The small circular one is 2in in diameter, and the long one about 2in by 6in.

The small brush has a 1in diameter hole drilled in its centre. A tinplate washer with a 1¼in. diameter central hole is soldered to the sloping end of the tube. Small wood-screws secure this washer to the top of the brush.

LARGE BRUSH

The large brush is made in a similar way, the cut-out being about 1in by 4½in. The piece "C" is then bent up and soldered to a flat piece 1¼in by 5in. This flat piece has a central cut-out 1in by 4½in and is screwed to the top of the brush so that its opening is over that in the brush. To facilitate the use of this wider brush on carpets and floors, the tube soldered to it should be about 18in or more long.

Do not fit either brush flat with the end of the tube, or it will be found the duster is awkward to use. An angle of about 45 degrees is most convenient.

The dust bag was made from a piece of material about 18in by 12in, folded over and sewn to form a bag 12in. deep and 9in. wide.

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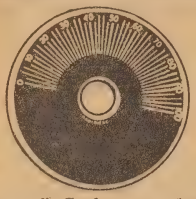

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CURRENT	RECEIVE
C.W.	RECEIVER
DOUBLER	REGENERATION
EARTH	SHORT WAVE
FILAMENT	SELECTOR
FOCUS	STAND-BY
FINE	SELECTIVITY
GAIN	SPEAKER
GRID	SWEEP
HIGH	SYNC
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KEY	TRANSMIT
LOW	TUNER
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MILLIAMPS	VOLUME
METER	V.F.O.
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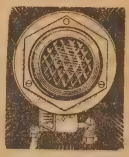

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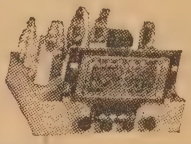

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The open end is placed over the outlet of the blower and secured by a strong elastic band, doubled and with a small wire hook at the end. (This was found easy to remove and replace, only a few seconds being necessary to empty the bag.)

The rear end of the bag is supported by a tape loop which is slipped over a small hook on the motor casing.

The material must allow a current of air to pass, but should be closely woven. If dust escapes, this will show the cloth is too coarse, but any kind of "proofed" material must not be used, or the flow of air will be too severely hindered.

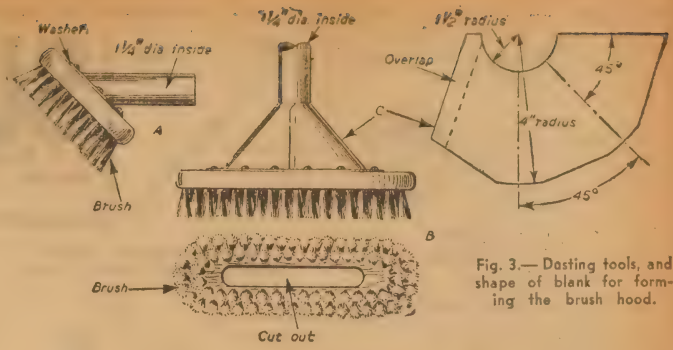

Fig. 3.— Dasting tools, and shape of blank for forming the brush hood.

IN THE COUNTRY

In country homes the machine may possibly be operated direct from storage batteries or from a 32 volt lighting plant, in which case it is simply a matter of providing a flex of sufficient length to reach to the source of supply. With a 12 volt system there is a possibility of excessive voltage drop with a long lead, since the current will be something over 2 amps.

When connected for 24 volt operation, the motors should be quite safe with 32 volts applied, the extra suction thus obtained being an advantage. The current is lower and the flex may be extended over practically any distance without excessive loss of power.

Most readers will be able to make use of the 50 cycle power supply mains. If you are having a transformer specially wound for the job it should be designed to deliver 50 volts. The motor may then be connected for 24 volt operation. This is to be preferred to the lower voltage arrangement because there is less chance of power being wasted in the line. In either case the voltage is well below the danger level.

500-CYCLE TRANSFORMERS

Constructors with access to disposals parts may be able to make use of some of the 500 cycle transformers which were used in certain radar equipments during the war. Naturally, they overheat badly when connected to their normal voltage at 50 cycles and most disposals dealers are only too glad to get rid of them for a few shillings.

However, we have found that they are an excellent proposition if operated at about one-third or less of their marked voltage. The regulation may not be all that could be desired, but this is of little importance for a job such as this.

One particular transformer, for example, has a primary rated at 80 and 180 volts 500 cycles and 450/0/450 volt secondaries. With the 250 volt 50 cycle mains connected right across the 450 volt secondary, the 180 volt winding delivers close to 50 volts under load and is ideal for operating the blower motor. There are possibly many other combinations which would work just as well.

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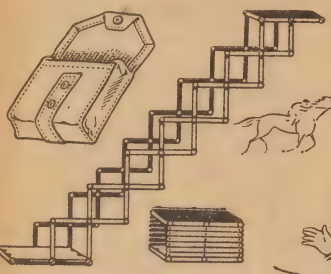

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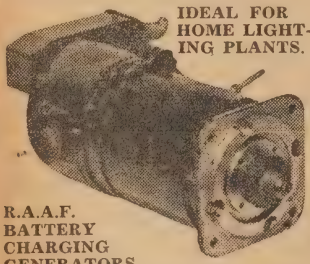

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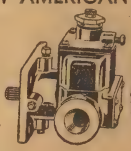

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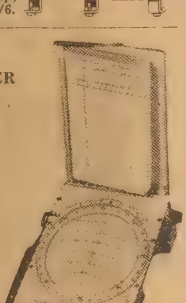

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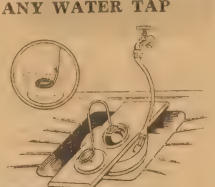

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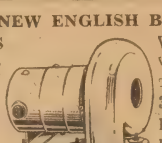

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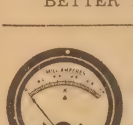

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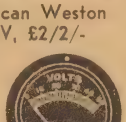

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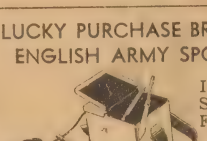

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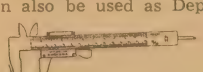
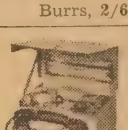
BRAND NEW ENGLISH VERNIER CALIPERS
Will measure inside and outside. Can also be used as Depth Gauge.



22/6
Ideal for all types of engineering work. Measures in ins. and m/m. Can be carried in the pocket.

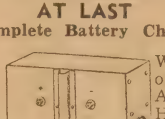
DRILLING OR ENGRAVING

HANDPIECE
Brand New . . . . . 20/- each
Burrs, 2/6 packet of 5.

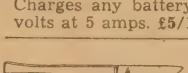


A Lucky Repurchase, £3/19/6.
Brand New Army Phones
Ideal for Farms
Install one in your workshop or house. Equal to P.M.G.

AT LAST
Complete Battery Charger
Fitted with brand new English Seliniur Rectifier



Works off 230v. A.C. Household Supply.
Charges any battery from 2 to 6 volts at 5 amps. £5/15/- complete.



SURGEONS' SCALPELS
6/6 each
Many other uses—Hobbyists Chiropody, Photography, etc.

THIS MONTH'S BARGAIN LIST

English Diagonal Cutting Pliers, 6/6
Extra Long Nose Radio Pliers, 8" long, pair 9/6
American Feeler Gauges 8/6
Dental Inspection Mirrors 5/6
Pressure Gauges, 0-200lb 25/-
Genuine British 4-draw 22 magnification Rifle Range Telescope £6/19/6
Pocket Compasses, English . . 5/9
Pocket Telescopes 12/9
Pocket Folding Telescopes optic glass lenses. Good range 57/6
Brand New Micro Switches . . 8/6
Morse Keys and Buzzer. Ideal for Boy Scouts. Cost £5, for 10/-
Brand New English headphones complete with cord and plug, 17/6

Telephone FJ5904

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nd Efficiently Despatched
LTERATION WITHOUT NOTICE.

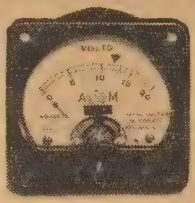
AMATEURS —DISPOSALS— EXPERIMENTERS

EXTENSION SPEAKERS

3 ohms impedance, connects in series with existing speaker. Complete with lead and on/off switch. Finish black brocade with chrome grill.

39/6

Postage and packing 4/- extra.



FERRANTI METERS

New 2¼" Square Flush Mounting Ferranti Meters. Supplied with eleven scales covering the following ranges of D.C. current and voltage.

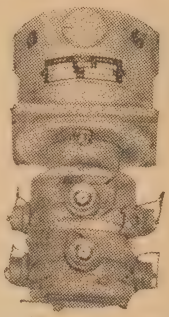
Milliamperes: 0-5, 0-25, 0-50 0-100, 0-250.
Voltages: 0-5, 0-25, 0-50, 0-100, 0-250, 0-500.

2% Shunts and Multipliers for any of the above ranges can be supplied. The meter is at present fitted with a multiplier and scale covering 0-20 volts. Printed directions supplied with each meter.

PRICES AS FOLLOWS:—

Meters complete with eleven scales	27/6 ea.
2% Shunts for Current ranges	3/6 ea.
Multipliers for Voltage ranges	2/9 ea.
Meter with the full set of eleven scales, five shunts and six multipliers	55/- ea.

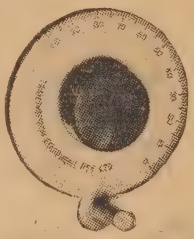
Postage and Packing 1/6 extra.



A.C./ D.C. MOTORS

Operates on either 24 volts D.C. or 50 volts A.C. R.P.M. 1750, H.P. approx. 1/20.

37/6 post free.



VERNIER DIALS

Transmitting type, 2½ inches in diameter. 0-100 etched scale. Positive action friction drive.

7/6 post free

POWER UNIT

Vibrator Power Unit, 12 volts input 300 volts at 100 mA output. Complete with 2 Vibrators and 2 6X5 valves. Circuit diagram supplied with each unit.

£4/5/- F.O.R.

MIDGET GENEMOTORS

Input: 28 volts at 1.1 amps. Output: 250 volts at .06 amps. Size: 4½ x 2¾. Weighs only 3 1-8lb. Perfect for use with 32 volt domestic receivers.

32/6

Postage and Packing, 3/-.

NO. 11 CABLES

Complete set which includes 1-10 point, 2-3 point and 1 Battery Connector.

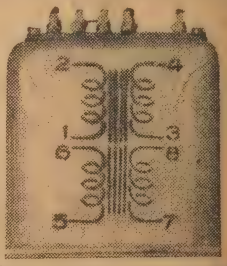
17/6 post free

KINGSLEY SPEAKERS

5 inch per-mag. complete with 5000 ohms transformer (6V6 matching).

22/6

Postage 2/6 extra.



LINE TRANSFORMERS

Four 600 ohms windings, excellent for use with Public Address and other types of Amplifiers.

12/6

Postage and Packing, 2/-.

Available also at —
No. 5 Royal Arcade, Sydney

PARAGON RADIO

Address all mail to —
Box 14, P.O., Haberfield N.S.W.

THEORY OF "PREFERRED" VALUES

You have probably wondered at times why apparently odd component values appear on many overseas circuits—values like 470 ohms, .22 meg and so on. Far from being odd, these values have a very logical basis, which is explained in the following article.

' is probably only a matter of time before these "preferred" values ll be employed universally and it noves all radiomen to become niliar with the system.

Far from being "screwy" the mbers have a very logical basis.

As you know, the normal stock lues of radio components have run m the early days in multiples of 2, 3, 4, 5, 6, 7, 8 and 9. What's ong with that, you say? Perfectly ical!

But say, for instance, you are de- ning an audio amplifier and, by periment, you find that a .1 meg ate load is a little on the low side. u are forced to used the next gher value, which is .2 meg, or to e a non-standard resistor or go to e expense of installing a second, wer value resistor to make up the sistance you require.

All of these solutions to the prob- n are clumsy for the very simple ason that there is 100 per cent fference between 0.1 and 0.2 meg.

At the other end of the scale the verse is true. For example, .9 meg only 12.5 per cent increase on meg. This is an unnecessarily fine aduation of values since most radio rcuits will work quite satisfactorily th all resistors and condensers thin plus or minus 20 per cent.

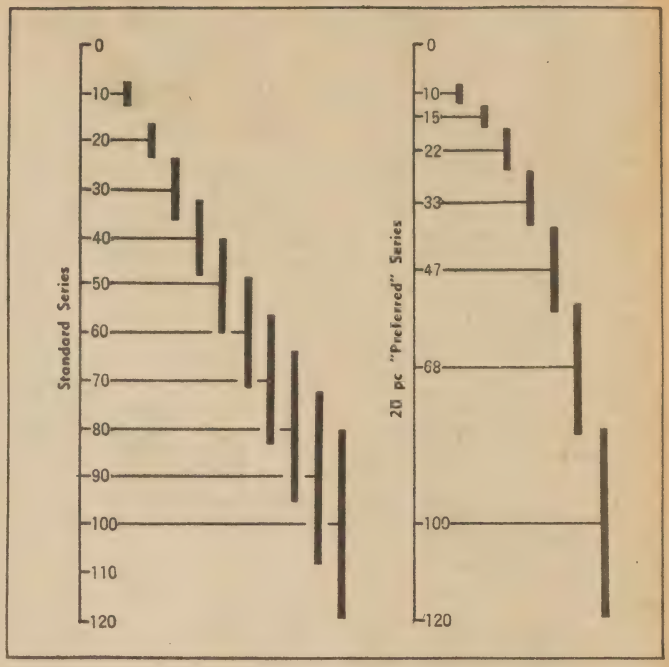
In any case, what is the use of pelling a resistor .9 meg plus or nus 20 per cent when it could be or 1.0 meg and still be true to bel?

In other words, percentage in- ease, not linear increase, is the portant requirement.

FICULTY OVERCOME

The "preferred" system of numbers ercomes the difficulty by pro- essing in relation to percentage. ote the accompanying table which ts the 20 per cent preferred num- rs between 10 and 100. A 10-ohm sistor minus or plus 20 per cent ay vary between 8 and 12 ohms, hile a 15-ohm resistor minus or us 20 per cent may be between 12 d 18 ohms and so on, through the ale. The system gives a contiunous nge of values with only very slight rerlapping toward the high end..

Considering the present system in e same way we find that a 10-ohm sistor minus or plus 20 per cent ay be between 8 and 12 ohms, but 20-ohm resistor minus or plus 20 er cent is between 16 and 24 ohms.



The left hand side of the diagram lists the standard values between 10 and 100 and shows the range within which each value may lie, given a tolerance of plus or minus 20 pc. The right hand side treats the 20 pc series of "preferred" numbers in the same way. Note that each number is approximately a 50 pc increase on the previous number and that no two numbers overlap appreciably.

"Preferred" Component Values

20% Tolerance	10% Tolerance	5% Tolerance
10	10	10
		11
	12	12
		13
15	15	15
		16
	18	18
		20
22	22	22
		24
	27	27
		30
30	33	33
		36
	39	39
		43
47	47	47
		51
	56	56
		62
68	68	68
		75
	82	82
		91
100	100	100

As you can see, successive values are widely separated. However, at the other end of the scale the overlap is very great.

In the case of the 20 per cent of preferred values each successive number is approximately 50 per cent greater than the previous number.

You can appreciate, therefore, that the system has a distinct advantage from the economic point of view. Instead of stocking 10 values to cover a 10 to 1 range your dealer need only stock seven components. And yet with the fewer components he is able to give you a better practical range of values.

This is all very true for home constructors or experimenters, but how much more so for large organisations

The table at left shows the preferred numbers in the 20 pc, 10 pc and 5 pc series. Values from the 20 pc series may have a tolerance of as much as plus or minus 20 pc but values from the 10 pc series would have a tolerance at least as good as plus or minus 10 pc &c.

where sorting time, storage space, spares, &c., are major considerations. In this country, scientific bodies, civil aviation authorities, large radio factories and military authorities are leading the change to the new system, since the economic and technical advantages are most apparent.

With the present system, considering resistors between .1 meg and 1.0 meg, the average retailer would be able to supply .1 meg, .2 meg, .5 meg and 1.0 meg. You may be able to obtain .4 meg or .7 meg, &c., sometimes, but these are not part of the usual stocks.

The preferred values nearest to the above series are .1 meg, .22 meg, .47 meg and 1.0 meg. Note that these last are actually every second value in the preferred series.

In other words, usage has tended to rationalise the present system. It is a very simple matter then to substitute .22 meg and .47 meg for .2 meg and .5 meg, where a 2 to 1 progression is required.

If the circuit requires that the resistors be chosen to within closer tolerances, the .15 meg, .33 meg and .68 meg values can be introduced. In this case the current odd values like .6 meg, .7 meg or .8 meg can be eliminated as, for all normal applications, the standardised .68 meg resistor would serve.

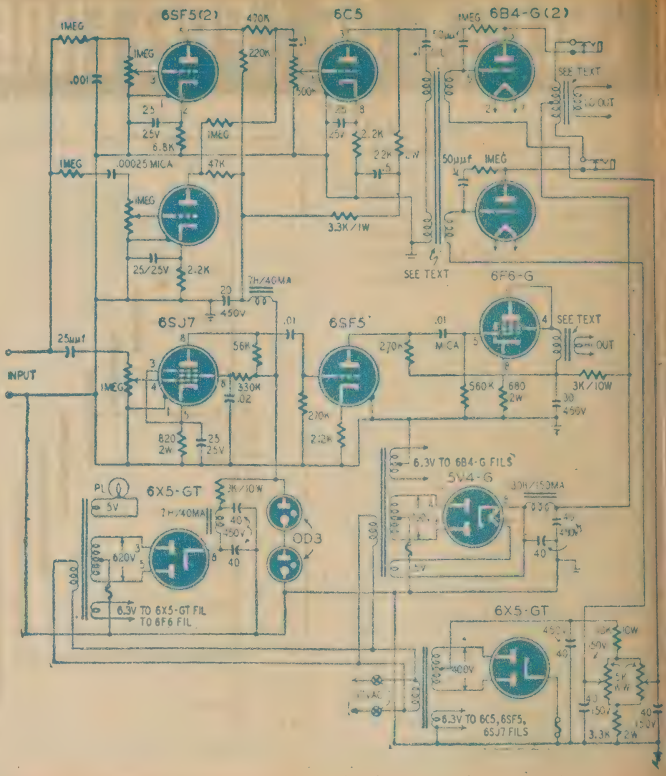
We have used the resistor range between .1 meg and 1.0 meg since it is a familiar illustration. However, the remarks apply equally to all multiples of the values quoted as well as to condenser values.

OVERLAP

To clarify the argument, we have confined the discussion so far to the 20 per cent series of preferred numbers. However, where a greater range of close tolerance values is required the system can be extended to a 10 per cent series, a 5 per cent series and even a 2½ per cent series, if that should be necessary. We have shown in the table how the 10 per cent series fits in between the 20 per cent series.

Quite obviously there is little point in making the resistors in the 10 per cent series to plus or minus 20 per cent because they could overlap values in the 20 per cent series and still be within tolerance.

Therefore, it can be assumed that any resistor from the 10 per cent series (12, 18, 27, 39, 56 and 82) will have a tolerance at least as good as plus or minus 10 per cent.



This amplifier circuit, reprinted from Radio-Electronics, shows how the preferred series is used in practice. Values from both the 10 pc series and the 20 pc series appear.

However, there is no reason why components in the 20 per cent series cannot be selected to a tolerance of 5 pr cent or 1 per cent, if necessary.

Therefore, don't confuse the term "20 per cent series of preferred values" with the term "20 per cent tolerance." The two terms are distinctly different.

There are certain applications where the preferred system of numbers is apparently inconvenient. Meter multiplier resistors, for example, could not conveniently be lifted from a stock of preferred values. However, such resistors cannot be obtained from a standard system either, in the ordinary way, since they have to be specially chosen for a small tolerance. In any case, the percentage of the resistors used in this application is small.

A 6V6-G output valve requires a 250 ohm cathode bias resistor in the usual class A1 cathode biased condition. A 220 ohm resistor from the preferred series would not be suitable and therefore sceptics may argue that a special resistor which does not belong to the series is required. However, the 250 ohm resistor does not belong either to the general selection of resistors in the old series. It is simply a special value which has become common because of its application and the introduction of the preferred system would not affect such special values.

New marine gas turbine

A MARINE gas turbine engine, the first for installation in a commercially operating merchant ship, will soon be tested at the Rugby, England, works of British Thomson-Houston. It is for use in the tanker Auris.

Details of the engine are not revealed. Many gas turbines are in use in America in stationary installations. The US Navy is conducting experiments with a marine gas turbine but as yet this type of power is not used on shipboard. Four gas-turbine electric locomotives are now in experimental use on railroads of the world, and several installations of gas-turbines, commonly called the turbo-pro-system, are in use in both American and British aeroplanes. The gas turbine is an efficient engine in which high-pressure gas resulting from combustion is forced against blades or vanes on a shaft to cause the shaft to rotate. It might be called the successor of the steam-turbine which utilises high-pressure steam to rotate the shaft.

The customary fuel used in the gas turbine is oil but it can be operated with natural gas as fuel. A coal burning gas turbine is under development. It uses for fuel a very finely divided type of coal, blown into the combustion chamber with air. One particular advantage of the gas turbine, besides its thermal efficiency, is its suitability for use where water is scarce. No water is required for its operation.

SHORT WAVE NOTES BY RAY SIMPSON

FLASHES FROM EVERYWHERE

AUSTRALIA: We cannot do better than commence our Flashes from Everywhere column with an interesting item regarding our own Radio Australia. Listeners in the Eastern States have been used to hearing Graham Hutchins' DX session at 3.30 pm on a Sunday afternoon but as from early in April this program is to be given at 5.0 pm on Saturdays on the two following frequencies 9.58 mc and 11.76 mc. Another popular program from this station, Listener's Choice, is now to be heard on Saturdays at 4.02 pm on 11.76 mc. This latter program is directed to listeners in Britain, Europe and New Zealand.

SAN MARINO: A few weeks ago some of our New Zealand friends were hearing a station on 3.99 mc which had every appearance of being located in the tiny country of San Marino. There was an identification signal of piano notes also a bird whistling at 25 minutes past and five minutes before each hour, the programs being heard around 5.30 am.

However, latest advice from Art Cushen now gives this station as yet another outlet of the Italian station although they actually use a slogan, Radio San Marino, at certain times. According to Art this new station is heard at quite good strength in New Zealand which is quite surprising considering the low frequency

BOLIVIA: Here is a South American country which has never been heard at all well in Australia although there is supposed to be nearly a dozen short-wave stations in operation. One of the best known as far as overseas listeners are concerned is CP38 and according to the latest issue of the NZ DX Times, this station, which operates on 9.505 mc from La Paz, is known as The Southern Cross Radio Station and is a British-owned station operated by the Canadian Baptist Mission and is heard in English till 12.25 pm. Nearly a year ago now we reported hearing a Bolivian station on 5.97 mc but could not identify the call letters. This has now been confirmed as CP13, Radio Constitucion, La Paz.

ISRAEL: The Israeli station at Tel Aviv has up to the present been using 6.83 mc under the call sign 4XB31 and on 9.0 mc as 4XB21 and from 4XB24 in Haifa on 8.17 mc. According to latest information, Kol-Israel plan to inaugurate new high powered M/W and S/W stations on May 14, Independence Day.

Frequencies allocated are 21.465 mc; 17.88 mc; 15.415 mc; 11.935 mc; and a frequency in the 31 metre band where 9.5 mc, 9.615 and 9.64 mc have been tested. The M/W station will use 1025 kc and the Voice of Zion programs will also be transmitted over the new transmitter. We are indebted to Radio Australia for the above information.

NEW VERIFICATIONS

TGTA GUATEMALA: This is another case where patience has been rewarded as our report to the above station was sent out in April, 1949, and the reply arrived in April, 1951. Their verification was in the form of a Christmas Card with details of the station shown inside

The actual verification details were typed in on the oposite page. The station is known as Radio Bolivar and they transmit as TGT on 1390 kc and on short-wave as TGTA on 6.335 mc. Another of their titles is Emisora de Super-Claridad Tonal which is shown above a microphone which also carries the station call letters.

TAV TURKEY: Although perhaps other listeners have already seen the latest verification card being sent out by the Turkish Radio Station at Ankara we had not seen it until we received ours confirming reception of TAV on 17.84 mc which listeners will remember was testing a few months ago.

This new card is printed in green, blue and white and shows a map of Turkey with a large radio tower rising from the capital Ankara. Alongside are the verification details which are all in English. The address is given as Turkish Press Department, Radio Branch, Ankara, Turkey.

THIS MONTH'S NEW STATIONS

TAHITI: Until comparatively recently this country was a very elusive one but most listeners have now heard them in the 25 metre band during their regular broadcasts around 2.30 pm. They were supposed to be moving to another frequency around 9.3 mc but at time of writing we have heard no reports.

There is news of them, however, from USA where it is reported that they have been heard weakly from 2.0 pm to 2.45 pm daily on 6.04 mc. Another report gives the frequency as 6.135 mc but as we have not heard them ourselves we are unable to say which of these two channels is correct. It does seem, however, that they are operating somewhere in the 60mc band so keep a lookout for them and compare the program with that on 12.08 mc.

SPAIN: It was a real surprise to find the well known Radio Nacional de Espana in Madrid moved from its long used channel of 9.369 mc. For some time now they have been right in the 31 metre band on 9.585 mc though actually at time of writing have moved back to their old outlet.

At 6.30 am when their English program is in progress they are heard at great strength and announce their frequency around 6.45 am and continue with news in Spanish until leaving the air at 7.0 am. For years now this station has been like an orphan outside the band but now is still another to overcrowd the already congested 31 metre band. They seem to be interested in reports and regularly send us their attractive little booklet.

ANGOLA: This Portuguese colony in Africa has an amazing number of short-wave stations for so small a territory and we now have news of still another two which have recently been logged. The first one is CR6RJ which is located in Huila and is now transmitting on 9.755 mc from 3.0 am to 5.0 am daily and on Mondays from 3.0 am to 4.40 am.

THE B.B.C. IS TESTING ON V.H.F.

From one of the latest issues of the BBC publication London Calling we note that they are now carrying out experimental transmissions on VHF.

THESE very-high-frequency broadcasts are in the nature of comparative tests of the rival systems of amplitude and frequency modulation. The station which is located high above the Weald of Kent some 20 miles south-east of London, is the most powerful of its kind in the world, and is providing data on the possibilities of a regular service of three metre broadcasting.

The station stands on a hilltop almost hidden in a small wood. But you can look out from it across the fields and orchards of the Garden of England, and beyond them to the rising skyline of the Weald. Dominating the station is the 470 foot mast. For the first 360 feet it is a slender, lattice tower, and from that there rises a tall, metal column—the aerial system. The buildings below house the two transmitters.

From the results so far obtained it would appear that frequency modulation gives greater range, power for power, and musicians who have heard it say it gives better quality, too. In the next few months the experiments will be finished, and then the engineers will report finally on the merits of the two systems.

Short Wave Notes for the June issue are due on May 5. For the July issue they are due on June 9. Please send them direct to Mr. Ray Simpson, 80 Wilga Street, Concord West, NSW.

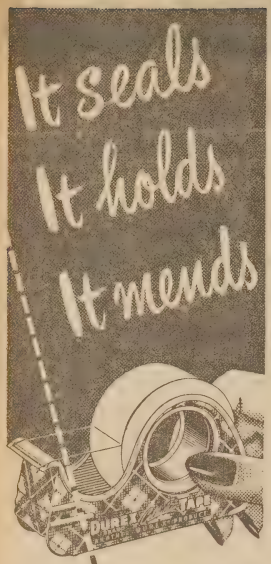
RADIO AUSTRALIA SCHEDULE

AS from April 10, Radio Australia adopted a new schedule and as this station is very popular with Australian listeners as well as those overseas, we are publishing their new operating hours in full.

3.45 pm to 6.15 pm VLC9 17.84 mc S. & S.E. Asia.
4.00 pm to 4.45 pm VLA8 11.76 mc Tahiti and Europe (Not Sat.).
4.00 pm to 4.45 pm VLG11 15.21 mc Indo China.
4.00 pm to 6.15 pm VLB9 9.58 mc Britain, Europe, and NZ (Sat. only).
4.45 pm to 6.15 pm VLA8 11.76 mc Britain, Europe, and NZ (Not Sat.).
4.00 pm to 6.15 pm VLA8 11.76 mc Britain, Europe, and NZ. (Only Sat).
4.45 pm to 5.30 pm VLG11 15.21 mc S.E. Asia.
5.45 pm to 6.45 pm VLG11 15.21 mc New Caledonia.
6.28 pm to 11.55 pm VLA6 15.20 mc To Forces.
6.28 pm to 7.50 pm VLB4 11.85 mc To Forces.
6.28 pm to 9.45 pm VLC4 15.32 mc S. and S.E. Asia.
7.00 pm to 11.30 pm VLG11 15.21 mc China and N. Asia
8.00 pm to 2.15 am VLB4 11.85 mc S and S.E. Asia.
10.00 pm to 12.45 am VLC7 11.81 mc N. America.
12.00 am to 12.45 am VLA6 15.20 mc Britain, and S. Asia.
1.00 am to 2.15 am VLA8 11.81 mc N. America.
1.00 am to 2.15 am VLC5 9.56 mc Africa.

NEW STATION LOGGINGS

Call	Kc	Metres	Location	Time Heard
ROME	3990	75.30	Rome, Italy.	5.00 am.
APL	4810	62.37	Lahore, Pakistan.	1.00 am.
ZQ1	4950	60.61	Kingston, Jamaica.	9.30 am.
OQ2AC	4980	60.22	Elizabethville, Bel Congo.	3.00 am.
VLC5	9560	31.38	Shepparton, Vic.	1.00 am.
WARSAW	9570	31.35	Warsaw, Poland.	3.30 pm.
APK	11725	25.59	Karachi, Pakistan.	10.00 pm.
CE1515	15150	19.80	Santiago, Chile.	1.00 pm.



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TRANSPARENT AS GLASS — SEALS AT A TOUCH WITHOUT MOISTENING

Cover a broken fingernail with "DUREX" Tape. Trim to shape, then cover with nail polish and you can't tell it's broken.

Handy Plaid Dispenser with
300 ins. ½ in. TAPE, 2/6
150 ins. ½ in. TAPE. 1/3
100 ins. ½ in. TAPE. 1/-
PLASTIC HAND DISPENSER only 3/-. Tape extra.
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LET'S BUY AN ARGUMENT

(Continued from Page 67)

feed audio from a central amplifier to speaker points all over a showground. It would be impractical to extend the plate leads from the amplifier that far and simple arithmetic will prove the failing of extended leads to the voice coil.

Let's say that the most distant speaker was 200 yards from the amplifier, entailing a total length of wire (there and back) of 1200ft. If the run were made with 23/36 cable, the DC resistance of the line would be about 9 ohms.

Imagine the losses feeding a 2 ohm voice coil through a 9 ohm lead.

Our PA man solves this one very nicely by providing the amplifier with an output transformer matched to a load high enough to swamp out likely losses in the line. At the speaker end, another transformer is fitted stepping down from the "line" impedance to voice call.

Once again, the exact value of the "line" impedance doesn't matter much, provided the correct loading is maintained. As often as not, our PA man adopts the same nominal 500 ohms as the engineer in the broadcasting station. It simplifies things for everybody concerned to regard this as a standard.

All very logical, surely.

NOW LET'S SEE

But let's come right back to the beginning, to the case of the fellow who intended to do things properly!

Taking the most adverse possible condition, he might be using a speaker with a 2 ohm voice coil, operated at the end of a 30ft lead — and that allows for a fair sort of a room.

By selecting power flex and connecting two of the three wires together, the total line resistance would amount to about 0.2 ohm, representing a loss in transfer efficiency of about 9 pc. This would have negligible effect on frequency response.

With an 8 or 15 ohm voice coil, as we might expect in an expensive set-up, the effect of an 0.2 ohms of line resistance would not be detectable.

Now the alternative is to purchase an output transformer with a 500 ohm secondary instead of 2.5 ohms. This may mean a slightly higher transfer efficiency to the line amounting to 3 or 4 pc at the most.

But, wait a minute, the signal now has to pass a second transformer, and even if it is as big and expensive as the first, it probably won't be better than 85 pc efficient at the most. Add the two effects and you're right back where you started from with about the same loss in both systems.

EXPENSIVE DISTORTION!

Here's the rub. The extra output transformer cannot do anything but deteriorate the signal, and for the privilege you've paid out a good three or four pounds. If you haven't paid that much, you've probably got a pint-sized line-to-speaker transformer with about 60 pc efficiency and a pretty poor response curve into the bargain.

Yes, believe it or not, I've seen it done — an amplifier with a big, expensive output transformer (just like the book said) feeding into something about a quarter its size. Yer gotta' laugh!

By way of conclusion, I saw an impressive demonstration recently by a lass who was credited with "absolute pitch." With uncanny accuracy she picked notes, chords, discords and runs played at random on a piano keyboard. The explanation offered was that she had a unique sense responsive to this absolute musical pitch.

I can't see it myself. Pitch is an arbitrary quantity having no obvious fundamental relationship to the senses. I am inclined to credit such demonstrations merely to an acute memory for pitch plus an adequate musical knowledge. What do you think?

KEEP YOUR HEADLIGHTS BRIGHT

(Continued from page 94, April issue).

This done, you can assume that the active lead is in as good condition as you can make it. But don't leave the job there. The return circuit via the frame can be responsible for additional loss of voltage.

In many cars, the reflector makes contact with the lamp housing only through two or three spring clips. At the very least, you should clean the spot where the clips make contact right back to the bare metal. Better still, sweat a lead between the rear edge of the reflector (where the heat won't affect the plating) and the body of the lamp housing.

Then, with the lights switched on, connect the voltmeter leads between the lamp housing and the car chassis —a plated fender will do. Any movement of the pointer will mean some voltage drop in the return circuit.

This is often due to rust in the movable lamp housing socket, while the weather strip between the fender and body may be responsible for a poor electrical contact at this point.

You can please yourself whether you correct the trouble at its source or take the alternative course of running a return lead right from the reflector, through the existing wiring channel to a lug under a body bolt. You may easily save a quarter-volt in this way.

It may not sound much — just a volt or so, and you would certainly not see the difference between 5.5 and 5.6 volts, but the meter tells its own story. A little loss here and a little loss there, each unimportant on its own, can amount to a very significant total and make all the difference between good lights and bad lights.

THE HAM BANDS WITH BILL MOORE

Federal Councillors and the Federal Executive of the WIA assembled during Easter for the 21st Federal Convention held in Melbourne. They decided Federal WIA policy for the forthcoming year.

BUSINESS sessions ran continuously from midday Friday to midday Monday—three sessions a day. The convention discussed and made decisions on the 44 items listed on the agenda paper.

The final session was devoted to an informal open discussion on any subject. It was a new innovation and allowed delegates and the Federal executive to debate matters not listed on the agenda paper. The session was a great success and is certain to be incorporated in all future conventions.

COUNCILLORS

The following Federal councillors and observers attended: New South Wales, delegate John Moyle (VK2JU), observer Vaughan Wilson (VK2VW); Victoria, Colin Gibson (VK3FO); Queensland, John Thorley (VK4RT); South Australia, George Bowen (VK5XU); Western Australia, George Moss (VK6GM); Tasmania, Bob O'May (VK7OM).

Last year's Federal president Bill Gronow (VK3WG) occupied the chair for the first period, then the new president George Glover (VK3AG) took charge.

The new Federal executive is as follows: Federal president, George Glover (VK3AG); Federal secretary, Max Hull (VK3ZS); G. Manning (VK3XJ), G. Weynman (VK3XU), W. Gronow (VK3WG).

Many important matters were discussed and the full minutes will be published in the official organ of the WIA, Amateur Radio.

Some of the matters discussed were as follows:

The 1951 DX contest will be known as the VK/ZL 1951 Jubilee DX contest and will be conducted by the Federal contest committee, which will be located in NSW for the ensuing year.

EMERGENCY PLAN

Emergency working with reference to civil defence was discussed and a plan produced for a national emergency network.

The scoring system for the 1951 Remembrance Day contest will be varied to allow all States to operate on a more even basis.

A new Australian award, WAAS (worked all Australian States), will be introduced. The basis for the award has to be worked out.

The draft of the uniform constitution for all divisions was discussed and will be submitted to all States for ratification. It is anticipated, in view of the comment, it will be accepted by all divisions.

Delegates and the Federal executives spent their Easter working for amateur radio and it is hoped their efforts were appreciated. Nearly 25 hours were spent in session and the full report of the proceedings will be awaited with interest.

The most important postwar development in amateur radio is the listing in the United States of concrete arrangements for civil defence working for amateurs during wartime.

It is important to us for many reasons. It provides an opportunity for the hobby to demonstrate its value in another sphere. It should allow the greatest contribution yet made to national welfare and offers the greatest challenge ever presented to amateur radio.

Recently the daily Press announced the appointment of a head of a similar Civil Defence Administration here in Australia. There seems to be no reason that radio amateurs in this country cannot offer to our Government and the people of the Commonwealth a similar service. We should be able to form for national emergency a secondary communications net.

DEFENCE IN USA

The plan in the US is being developed rapidly and a most important announcement has been made by the Federal Communications Commission. It specifies the special frequency bands for use by amateurs in civil defence working in the event of war.

Frequency bands are as follow:

. 1800-2000 Kc (under the existing restrictions as concerning Loran).

3500-3510 and 3990-4000 Kc (two 10 Kc bands).

28.55-28.75 and 29.45-29.65 Mc (two 200 Kc bands).

50.35-50.75 and 53.35-53.75 Mc (two 400 Kc bands).

145.17-145.71 and 146.79-147.33 Mc (two 540 Kc bands).

220-225 Mc.

The FCC also announced that the 1750-1800 Kc band will be available for use by qualified amateurs authorised to operate in the Disaster Communications Service.

Amateurs now have a definite assurance that these frequencies will be available and that their services are required in this special field when normal activity is shut down during war.

REGULATIONS

The actual regulations governing operation in CD work are as yet not drawn up, but work upon them is proceeding. They, of course, will possibly vary widely from normal as it will be a widely different service.

The actual regulations when gazetted should make interesting reading. Main emphasis will be on the UHF's with their restricted coverage. The 1.8 and 3.5 Mc bands will be apparently used for special distant circuits only.

The US Government has recognised the worth of amateur radio in fostering these regulations and the ARRL is playing a big part in the negotiations.

At the moment preliminary organisation by the ARRL is proceeding through their Amateur Radio Emergency Corps (AREC) and amateurs are requested to advise their local co-ordinator whether they are willing to co-operate in CD working.

Many problems will arise such as security clearances. The question of blanket authorisation to operate will also have to be decided.

It is the biggest challenge ever presented to the hobby and amateurs throughout the world await the final result with great interest.

NORTH COAST CONVENTION

During the Easter weekend, and in glorious weather, members of the North Coast zone of the WIA and visitors gathered for their annual convention at Urunga.

The very extensive program kept everyone busily engaged. More than 70 attended the function, including interstate visitors George Heilbronn (VK4GG) and Frank O'Dwyer (VK3OF). It is functions of this type which provide country amateurs with an opportunity of social contacts, so lacking out of the metropolitan areas.

Official representatives from the division were the president, Jim Corbin (VK2YC), and councillor Dave Evans (VK2AYE), while Hart Wall (VK2JC) was chairman of the convention.

Main activity was centred around the three contests, and they attracted many entrants. The Hunter branch indicated prior to the convention that they would be entering some stiff competition—they did! We are rather used by this time to the Newcastle gang taking out a goodly number of the prizes at field days, &c.

TROPHIES

The 7 Mc power handicap contest run over three hours Saturday afternoon for the Gerry Challender (VK2ZS) Memorial Trophy was won by Harold Whyte (VK2AHA), with Jim Cowan (VK2ZC) (both of Newcastle) in second place.

Early Sunday afternoon parties assembled for the 144 Mc hidden transmitter search.

The result was just a repetition of the placing for the Remembrance contest. First place Harold Whyte (VK2AHA), second Jim Cowan (VK2ZC).

Congratulations to these two ama-

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teurs. They recorded a sterling performance—a reward for the hard work put into the equipment used. VFO controlled transmitters were used in the 7Mc equipment, while the 144Mc gear was finely constructed.

We are pleased to record that in the third contest the Urunga Scramble conducted over an hour on Sunday afternoon was won by a combined western and coalfields zone effort. John Meagher, VK2AMV, supplying the transmitter and Jack Hill, VK2ADT, the receiver. Second, Jim Cowan, VK2ZC.

Sgt. A. Glasscock, VK2ZI, of the Wireless Section of the NSW Police, specially journeyed to the convention to explain the emergency communication programme for the North Coast area, and explained how amateurs could assist in such work.

Mr. Brisland, radio inspector in charge of the area, was also in attendance and supplied answers to the many questions presented on regulation matters.

Mr. and Mrs. Ernie Baker, VK2FP, won the lucky number prizes and Frank O'Dwyer, VK3OF, was awarded a prize for travelling the longest distance to attend the convention.

On Sunday morning the official WIA broadcast was presented from the convention over VK2XO Raleigh.

Crieff Rettalick, VK2XO, North Coast zone officer, and Percy Sara, of Bellingen, were responsible for most of the organisation and made it possible for such a successful convention to be held.

UHF SECTION

Election of office-bearers for 1951-52 for the NSW UHF section resulted as follows: President, Dr. Bob Black, VK2QZ; Vice-Presidents, Ray Hancock, VK2YM, and John Miller, VK2ANF; Secretary, Cess Cronin.

Don Knock, VK2NO, has been appointed sub-editor in NSW for Amateur Radio. Don would be pleased to receive notes for rewrite not later than the 1st of each month at his home address, 43 Yanco St., Bronte.

The NSW Division of the WIA has been given the use of a complete station by Mac Hicks, VK2ADV. The station to be set up in a central position in the city for the promulgation of WIA official broadcasts. The donation is an extremely generous one, greatly appreciated by all members and will considerably assist the Division.

Conditions over the last twelve months have deteriorated on our high frequency bands to such a degree that amateurs can hardly recognise the DX bands of a few years ago.

It must be disappointing to newcomers to find the 14 and 28Mc bands so flat that for hours on end they are not workable.

Old-timers remember no parallel to the present conditions since 1930, when the bands as we now know them were introduced.

For the first few years the 14 and 28Mc bands were not used very much most DX being contacted on the 7Mc band. From about 1934 onwards activity increased on the first two bands until we saw the intense population of postwar.

IONOSPHERIC CHARTS

The Ionospheric charts for amateur radio bands published in Amateur Radio tell the story of the last twelve months. The MUF (maximum usable frequency) and the LUF (lowest useful frequency) have been running close together. Look at the charts for 1947 and 1948 and you will see how the position has changed in the period. The chart for April, 1951, published in the March issue, shows no improvement either.

Similar conditions prevail, of course, throughout the world and at the moment we are in a period of maximum sunspot activity. DX has really tapered off over the last 12 months and we can anticipate at least a further twelve months before it returns to anything like normal.

Some unusual effects were also noted on 14Mc during the past month. On one particular evening station within a 50-mile radius operating on the 14Mc band whose signal strengths normally run from S3 to S6, peaked above S9 for a period of two hours.

Perhaps this could not be classed

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M2

s being brought about by Iono-
spheric conditions, but such a state
is not been noticed before.

On another evening ZL3AB and
K1NL, who were running at S8,
faded completely out in a matter of
seconds.

Let us hope the DX position im-
proves soon. If it does nothing else,
it will relieve the congestion on
7Mc, where quite a few of the 14
and 28Mc DX men have migrated
in an effort to break the monotony.

The VK5 gang have been taking
full toll of the Eastern US stations
coming through in the mornings the
long way round on 7Mc.

They seem to have the edge on
amateurs from the eastern States.
We remember Jack de Cure
K5KO's efforts to Europe on 3.5Mc,
always well ahead of amateurs over
this way.

7Mc provided the best piece of
DX for the month, VP5BH in the
Cayman Islands running 568 on
9945ks at 2130hrs, EAST. Promises
QSL, too.

CHANGING FACE

When we wonder at times why
more amateurs do not take a more
active part in amateur politics, we
really should consider the chang-
ing face of the hobby. These days
participation in amateur radio is
quite a complex business by the
time one builds all the equipment
necessary.

20 years ago one obtained a piece
of board, a few condensers, a tube
(not forgetting some copper tub-
ing) and had a transmitter. A day's
work and you had a receiver — a
few hours the antenna was erected.
The result was a lot more time for
personal contacts and for assisting
in amateur affairs.

Today the work falls on those
who resist the temptation to build
the complex gadgets that appear in
QST, &c. There seems to be no
answer to the problem.

Well-known DX man VK2EO,
Dave Duff, secretary of the NSW
Division, has lost none of his ability
to put strong signals around the
place. He recently presented a WIA
broadcast Sunday morning and
effected the best coverage over the
State yet recorded.

OPENINGS ON 50 MC

Occasional openings occurred on
50Mc during the last month but
sporadic E activity has lessened
with the advent of autumn. We
should remember the several warn-
ings of Ed Tilton, W1DHQ, UHF
editor of QST, to the effect that
sporadic E develops either side of
the shortest day of the year as well
as the longest. It is not anticipated
that openings during June will be
as frequent or widespread as during
December, but if more stations are
active than usual quite a number
of good contacts should be made.

YOUR OPPORTUNITY—

to join the world-wide ranks of amateur transmitters. The Wireless Institute of Australia holds regular classes in Sydney to assist Sydney and suburban enthusiasts to obtain their Amateur Operators' Certificates of Proficiency.
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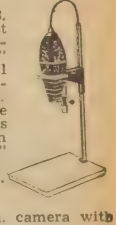

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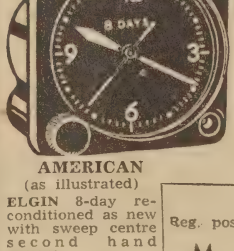

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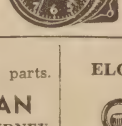

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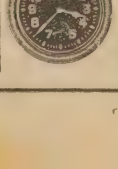
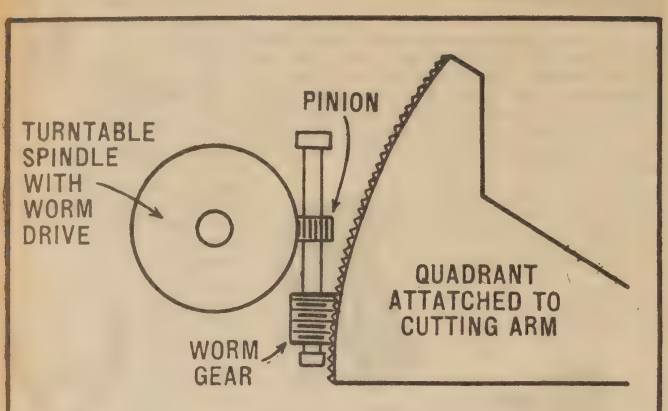


These WORLD-FAMOUS pocket (ex-Army) watches as illustrated, with all luminous dials, jewelled movements, with second hand, are worth £8/10/-. Reconditioned. As new. **65/-**

FURTHER NOTES ON DISC RECORDING



This diagram shows the gearing for a popular type of arm drive. It must run smoothly without binding if grouping is to be avoided.

The enthusiasm displayed by readers about home recording continues to grow. Although we were confident that there was a large field for recording equipment, we frankly had no idea it would prove so universally popular.

THERE hasn't been time enough to gauge the direct response to last month's Junior Recorder. It's a project in any case which isn't generally rushed by the average man, who must make calculations about parts, time, and not the least, his pocket book.

We have had plenty of time, however, to judge our own reactions to it, and the rapidly growing pile of good discs we have made is ample evidence that it is doing a job!

Main impression at the moment is that the discs generally speaking are so good that we are wondering whether a more elaborate design would be worth while.

It is possible to provide a few extra facilities, of course, and to build in more power as a useful safety margin. But at this stage it is doubtful whether improvements in frequency response, or further flattening of the cutting curve, would be worth while.

IMPROVEMENT

On paper any such improvement must be considered good. What we'd like to do is produce a curve which is virtually flat to say 8Kc, without being down too much at 10Kc, and arrange for a suitable pick-up which will be at least as good as this.

To obtain this improvement, a good deal of thought would be necessary and might bring with it the danger of complication. We have a number of ideas which will take some time to work out but it seems possible to produce a circuit employing the parts already in use for most push-pull amplifiers without in any way prejudicing them for straight record playing. In fact the circuit we have in mind could only extend their usefulness.

However, don't let these remarks affect your decision to make up the Junior. We repeat it is so good that we'd be quite happy with it in any circumstances and feel quite sure it will do much more than our readers would expect.

OUR RESULTS

Since the article was published, we have demonstrated results to many people, both in Sydney and Melbourne, and so far haven't been able to extract anything but unqualified approval. The opinions expressed by our four "guinea pigs" as quoted last month apparently hold good for just about everyone!

It may be, too, that the circuit as used has substantially reached the limitations of the cutting head which would make further work unprofitable. As improvement would almost certainly involve boosting the highs, a more powerful amplifier would be required to provide the extra power at the top end without danger of overloads.

by John Moyle
VK2JU

However these are merely remark in passing. The purpose of this articl is to add a few general comments t follow up the constructional detail given last month.

Queries have been raised as t whether the acetate discs normall available are just as good for micro groove as for 78 rpm.

So far as we can see, all standar discs behave satisfactorily wit microgroove recording. The lacquer used are invariably of a special typ and provided the cutting stylus is i good condition, will cut clean, quie grooves. We have probably not use every individual make available bu we have cut with most of them.

THE SWATHE

There is a subtle difference betwee various makes, which gives them different character. It's difficult to sa for instance whether one is "harder than another, but it is possible to dis tinguish them by the color and be havior of the swathe or fine threa which comes away from the stylus.

With most discs, cutting inside t out, the swathe tends to shrink an curl a little as it is cut. This effectiv shortening of its length tends t throw it well into the inside of th turntable, where it proceeds to pil up harmlessly into a neat coil. Wit some records, the swathe tends to li closer to the groove being cut tha with others and it is wise to brush i well into the centre from time t time with a soft camel-hair brush.

The object is to prevent th swathe from tangling around th stylus. When this happens you ma not be able to clear it and invariabl the smooth cutting of the grooves wil be spoiled at that point. It may pil so badly that you will have to lif the stylus and break the continuit of the recording.

Some quite effective devices ar available which automatically brus the swathe into the centre and ar nearly always used when cutting out side to in. They are almost a neces sity in any case with some blanks, disadvantage which often seems t go hand in hand with a harder, some what brighter disc.

SUCTION TUBE

Professional recorders use a suctio tube which picks up the swathe an carries it away from the cutting point This scheme is the best of all, bu isn't easily adaptable for home re corders. We have a few ideas of thi score, however, and may be able t suggest something in the future. I the meantime ingenious people wit a small blower motor — ex rada equipment—could probably dope u something with a light aluminiun tube running along the cutting arm and joining to a soft rubber tube a the bearing end to allow perfect free dom of the arm. The motor of cours would suck, not blow!

This scheme would not interfer with a quick turn-over of a dis when the second side is required fo

ong recording. We have become
ie practised in making a quick
of the recording arm, a record
ersal leaving the swathe sticking
he disc. It takes only a few seconds
this, and it can often be managed
ing a convenient break in the
ogram.

Always allow a few revolutions
er the gain control has been turned
before lifting the cutting head,
ather turning a record or finish-
r. If you have time, cut a silent
arter inch or so, so that you can
ch the turntable without rushing.
en playing back sometimes the
k-up will decide to sweep back
oss the record when it runs out
groove at the end and this will
n spoil the disc if allowed to
pen. Fortunately in most cases
stylus simply jumps back into
last groove but one and keeps on
ng so ad lib. But it's tempting fate
allow this as a regular thing.

EANING

Don't cut too near the outside if
can help—otherwise finger prints
handling marks will eventually
il the recording at this point. In
is connection, a clean handkerchief
your right hand is a good pre-
tion when handling completed
cs, which should always be stored
ight in paper covers and not
ked too tightly together. Your
cs will last a long time if care-
ly handled.

f dust sticks to them, a light brush
a circular manner with a lintless
ndkerchief barely damped with
ter will generally pick most of
p. Fingermarks are bad—they are
asy and the dust sticks to them.
hard to remove these completely.

At all costs see that your equip-
nt is free from any kind of hum.
e circuit is virtually humless but
generally good practice to have
recorder, the main chassis, and
extra playback motor, if any, all
ned together and earthed to a
od earth point. Otherwise electro-
tic hum can creep in.

The recorder itself should be
mly attached to a solid mounting—
h timber isn't too heavy. If a
ond motor is used for dubbing it
ist be free from rumble. A series
sistance in the mains lead to such
notor will reduce its pulling power
generally higher than necessary
yhow — and will often reduce
mble most effectively.

ROUPING

A few instances of "grouping" or
even spacing of the grooves have
en encountered by our readers. It
important particularly with micro-
oove that grouping should be as
arly absent as possible. With the
ver equipment, the arm is driven
rough a gearing system below the
rntable, as shown in the diagram.
nless this is adjusted to be perfectly
ee-running, grouping may occur.
Refering to this diagram, the main
urce of grouping would be bad
achining and irregular operation
the quadrant and worm gear. As
is is carefully controlled at the
ctory it is in practice the least
spect. The quadrant should be
sprung in such a way that its "lift" when engaged is just enough to be seen by inspection. There is no advantage in having too much pressure at this point.

Probably the most likely offenders will be the worm on the turntable spindle and the small pinion which it drives. It should be possible to spin this spindle by hand with the cutter engaged without any suggestion of binding at any point. If there is binding there will be an uneven run at this point and grouping is almost certain.

LUBRICATION

It is possible to move the pinion shaft to either side and thus control meshing by adjustment to the needle bearings which support it. Only a tiny movement may be needed to avoid this binding. It doesn't matter, apparently, if there is a small amount of slack at this point. It is taken up at all times by the torque of the motor and loaded steadily in the reverse direction by the pressure of the quadrant on the worm.

We have spent hours with our own equipment experimenting with this point, and had no trouble in reducing grouping to a mere shadow of regular bands a few grooves apart only detectable when the disc is held to the light at a certain angle. Grouping of this order is so small as to be negligible.

The complete gear train, particularly the spindle worm and the pinion should be kept scrupulously clean. Dirty grease and dirty oil lubricating the spindle socket, will be sufficient in some cases to cause binding. If in doubt, clean all the gears with a matchstick and kerosene, dry thoroughly and relubricate. Use light machine oil on the spindle shaft. Grease similar to Shell Mytilus A is best for the gearing.

LEVELS

Many of these points have been mentioned before, but apparently some are still being troubled about them.

The remarks in general will apply to all types of recorders. The overhead type will probably need even more care, as the feed mechanism is often exposed.

You may find that maximum recording level will vary according to the condition of the cutting stylus. A new stylus will cut cleaner than a blunt one, which tends to push the surface aside as well as cut. Quite good records can be made even with a worn cutter — within reason of course—but the highs tend to suffer and inter-groove modulation is much more likely when the tip is worn.

Incidentally we have had several styli reground to microgroove points and have found them quite satisfactory.

Finally, don't forget to experiment with groove depth when fitting a new stylus, starting from light cuts and gradually getting deeper. There is a fairly critical depth which will give the quietest cut but once found it will be satisfactory over a long period.

N.H.V. KITS

AMPLIFIER CABINETS

These streamlined amplifier foundation units consist of a standard chassis 3" deep with removable top in aluminium. Fitting over the top is a removable cover which has louvres on all sides and handles welded to the ends. Color Grey.

Catalogue No.	W	D	H	Prices plus Sales Tax
AC1	10"	5"	9"	£1 5 6
AC2	12	7	9	£1 12 6
AC3	17	7	9	£1 19 6
AC4	17	10	9	£2 15 0

Catalogue No.	W	D	H	Prices plus Sales Tax
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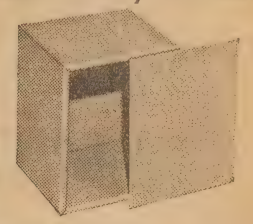
AC SF 1279	12	7	9½	£1 15 6
AC SF 1779	17	7	9½	£2 6 6
AC SF 17109	17	10	9½	£2 19 6

Metal Utility Cabinets



This line of Cabinet is for housing electronic equipment of all types. It has a fixed back and removable front. Color Grey.

Catalogue No.	D	W	H	Prices plus Sales Tax
MC666	6	6	6"	7/6
MC596	5	6	9	8/6
MC7810	7	8	10	12/6
MC6712	6	7	12	12/6
MC81010	8	10	10	15/6
MC81112	8	11	12	19/-
MC7915	7	9	15	19/-

Catalogue No.	D	W	H	Prices plus Sales Tax
MCSF776	7¼	7	6½	10/6
MCSF796	7¼	9	6½	12/6
MCSF7116	7¼	11	6½	14/6
MCSF8138	8½	13	8	17/6
MCSF101810	10½	18	10	28/6

N.H.V. KITS

97 MARRIOTT ST., REDFERN, N.S.W. MX3765.
An Associate of R. H. Oxford & Son Pty. Ltd.

OFF THE RECORD — NEWS & REVIEWS

Micro-groove records are still in the news this month, as more of them become available from various music houses throughout Australia. They have been sold almost as quickly as received, and it should not be long before a steady supply, if limited, is coming forward.

By JOHN MOYLE

DIFFICULTY in obtaining specific items may be due largely to manufacturing difficulties in England, where Decca seem to be working like Trojans to meet the terrific demand.

Many of their records are probably going to America where the long playing tide seems to be mounting to enormous proportions. Several who have recently returned from that country report that the long players are now part and parcel of the industry, and seem to have achieved permanent acceptance. American records I have heard indicate that the English Deccas are still at the head of their class, and this is borne out by examples of them I have heard here in Australia.

So far there is no indication that EMI have made any decision since their statement that six months' notice would be given before the release of any new type records. It is pretty certain, however, that when they do come, the standard will be at least as high as that set by the Decca company. Maybe that will be a day worth waiting for!

Meanwhile I have been able to hear one way and another most of the long players received here, and have heard nothing to modify my good opinion of them. Some are better than others, but I haven't heard one yet which I can say is a complete disappointment.

There is quite a difference between the best and the worst. The latter have most of the characteristics of the better 78's in that their surface noise is a little higher than normal, but not as high as the equivalent 78's would be.

NOT ALL FFRR

Not all records have taken advantage of the full frequency response, but the worst I could say of them is that they are good, and they have the advantage of unbroken playing. This alone makes them worthwhile, as the cost of an equivalent 78 set is about the same.

Some of the discs have warped a little—one in particular quite badly. Oddly enough, this didn't seem to affect reproduction to any degree, even with the pick-up rising and falling about one quarter inch. Fortunately a spell in storage under a heavy weight will generally flatten such discs, and I think examples of this type must be regared as exceptional.

Stress should be placed on playing all 33 records with the recommended maximum pressure of 7 grams which shouldn't bother slightly warped records. In this respect, the cantilever type of stylus suspension seems to have the advantage. This type of pickup appears capable of playing almost anything.

"PETROUCHKA" BEST

At the other end of the scale, I have heard some discs which are really superlative. I have finally managed to obtain a copy of the *Petrouchka* record played by the Suisse Romande Orchestra conducted by Ansermet. Right from its first release, this record was hailed on both sides of the Atlantic as being a highlight, and I agree with all that has been said about it. It is probably the best disc record ever issued, even though that seems a big claim to make. It has all the virtues that the long players can bestow—low surface noise, low distortion, uncanny definition, and the widest of frequency ranges.

It should be played for best effect on equipment which has been compensated to reduce the high note response in accordance with the accepted micro-groove curve. Without this, on wide range equipment the top register will appear far too strongly. Using average speakers,

CH.100.12

SQUARE DANCE music

on PARLOPHONE and DECCA Records

HONEST JOHN—Square Dance with Calls
Leonard Hurst with Jim Gussey Sextette .....
HONEST JOHN SQUARE DANCE—Practice Side
Jim Gussey Sextette A.7752

CAPTAIN JINKS—Square Dance with Calls
Leonard Hurst with Jim Gussey Sextette .....
CAPTAIN JINKS SQUARE DANCE—Practice Side
Jim Gussey Sextette A.7753

THE LAMPLIGHTER SQUARE DANCE—With Calls
Leonard Hurst with Jim Gussey Sextette .....
THE LAMPLIGHTER SQUARE DANCE—Practice Side
Jim Gussey Sextette A.7754

STAR BY THE RIGHT—With Calls
PRACTICE SIDE 1
Duel in the Sun Square Dance Orchestra Z.958

DOCEY DOE HOEDOWN—With Calls
PRACTICE SIDE 2
Duel in the Sun Square Dance Orchestra Z.959

FROM ALL LEADING MUSIC STORES

Columbia Graphophone (Aust.) Pty. Ltd., Homebush, N.S.W.
The Parlophone Coy. Ltd. (inc. in England), Homebush, N.S.W.

wever, a certain amount of de-phasis takes place because of the nparatively poor top response, but n so, there is undue predominance the upper middle register where h speakers show up a peak.

While in Melbourne recently, I d the pleasure of hearing this ord played with a wide-range k-up on a super gramophone ich sells for about £400. It was, course, compensated as already ntioned, and the total effect was lly something!

Which underlines the warning I ve made repeatedly, not to be sty if your micro-grooves sound bit edgy. In most cases it will be back of de-emphasis rather than ault with the records themselves. ce again I hope to do something out publishing suitable circuitry out this, but the pressure has been recently, and one can't do every-ng at once!

W TECHNIQUE

After the initial immersion in cro-groove sound, one becomes newhat blase about listening, and gins to pick faults which are mselves a tribute to the record-g in that they would not other-se be noticed. It would seem that new studio technique is being de-loped for recording which must y attention to the difference one n now hear in many instruments. other words, as the range widens, does the balance of the music it-f. Instruments have a habit of mping out of the blue, with their ll harmonic range apparent, which eviously could be left safely to ay along in the general mess, or is at too hard a word?

It means, too, as I have remarked fore, that wide range listening ally is listening, and can't be nored. Hearing what is practically violin right in the room, for in-nce, isn't the same as hearing e same instrument with the top gisters removed or smoothed over. ass becomes an orchestral section nich rips the air, and woodwind no nger languishes in the background.

Under these circumstances, re-rding can't leave anything to ance. That improvements are being ade hand over fist is demonstrated some of the 78's I have heard cently, which are sharing in the neral move to high quality.

JST MUSIC

All this is, of course, highly grati-ing, and means some wonderful nes for music lovers in the future. feel that recordings have passed at critical region beyond which we ject the sense of hearing records, d, free from the irritations of noise vel and constant interruptions, are ft with only the music itself.

That my reactions are shared by any others is evidenced by the ish for the records themselves. ey are being bought even by people ho as yet haven't the equipment th which to play them.

Leaving records for a moment, we ve received more and more mail out tape recorders, their capa-lities, availability, and special ad-ntages.

My own view is that discs and tape are two different things. Each has a definite case, and one is complementary to the other.

TAPE ADVANTAGES

Tape shines where records are made which aren't required for any length of time—they can easily be wiped out. It is valuable when the quality of a program isn't known, and which, if poor, will waste a disc. It can be edited, measured for duration, and otherwise prepared for eventual transfer to discs, which are so convenient for storage. These are more easily interchanged in playback from one machine to another. They are also quite cheap on a micro-groove basis, but good tape costs money.

I am interested at present in a proposition for a recorder which can combine both methods without being as costly as this would suggest. I must leave it at that for the time, but sometime in the future—I hope before long—there may be more to say about this.

We have also been talking about working out a home-built tape recorder which can be operated from a gramophone turntable, and in which most of the work will be inexpensive and mechanical. Again there is a good deal of work in such a project, but I thought many would be interested to know what is in our minds. Any reader who has been successful on these lines is cordially invited to write, remembering that we want something which isn't just good, but very good. Our discs at the moment are edging into the professional class and the tape would have to beat them for a start.

NOISE SUPPRESSION

ONE interesting point I noticed when listening to a microgroove record was the use of automatic noise suppression. This is a circuit which might aptly be called an automatic tone control. In order to keep down surface noise, the high note response of the recorder is automatically reduced when no high notes are being reproduced. A softly played piano would allow a top cut well down the scale. But a cymbal crash, requiring full range, would automatically remove the top cut for its duration.

On wide range equipment I could clearly hear the rise and fall of surface noise with variations in frequency response.

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6" .. .. 1/9 8" 3/9
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Hard • chromium plated needles with green shanks. Radius of needle point guaranteed accurate to within the tolerance of .002"/.003". Each needle will play 20 sides, and up to 50 without damage to record.
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A very useful motor, 50 volt, 50 cycle, which can be rewound to 1/10 horsepower 230 volt, diameter of shaft 5/8in., self-aligning ball races, ideal for handyman and hobbyists. Only, each **25/-**

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60 volt, 50 cycle, ideal for use with Rotating Beam Aerial **30/-**

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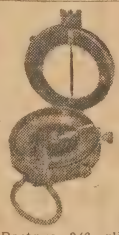
POCKET PRISMATIC COMPASS

Compact, Reliable Compass fitted with Prismatic Sight. Just arrived from England.

PRICE

£5



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MINE DETECTORS

The wartime mine detector is now doing a very useful peace-time job and has proved invaluable to PLUMBERS, GAS-FITTERS and MUNICIPAL COUNCILS. It originally worked on the principle of finding the metal casings of mines. When it found them it whistled.

Metal pipes and cables can be traced quite easily in the ground. This saves the laborious, costly and time-wasting digging of "search holes" when the underground path of the pipes is uncertain, as it frequently is. And throughout all the metal dectector "whistles while it works."

The unit consists of two interchangeable sweep coils, one large and one small, and is complete with carrying pack, valves and headphones, packed in strong, wooden transit cases. 10in. x 12in. x 4ft. 6in. (total weight 80lbs). PRICE £8/10/- ea. F.O.R.

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All generators checked and tested before despatch.

	£	s	d
24 volt, 1500 watt	15	0	0
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Combined 24-volt motor and High Pressure Hydraulic Pump, 6000lbs./square inch. **£3/15/-**

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Two four-foot sections, ideal for car aerials or fishing rods. Each **15/-**

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4000 ohm, suitable for crystal sets. PRICE, per pair **25/-**

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8-day clocks by the famous Waltham Clock Co., of America. Ex-U.S. Navy 24 hour luminous dial, showing date, hours, minutes, seconds. Size 3½in. Worth £25.

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Liquid Damped, Card Type, 6½" dia. x 3¾" deep, fitted with large viewing prism, ideal for small craft, &c., for normal navigation and also taking bearings. Each **£6/10/-**

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Stand. P.M.G. Type Phone PRICE, Each **3/6**

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SERVICEMAN WHO TELLS

(Continued from Page 63)

A smear of this will enable the nut to be stuck on the end of the finger, so that it may be carried to the end of the bolt.

A variation of this is shown in figure 6, where a piece of adhesive tape, sticky side out, is wound around the end of the finger. I have found this particularly useful where large nuts are involved, such as are sometimes encountered when re-installing a car radio. This often calls for the removal and replacement of some of the panel assembly nuts, and car manufacturers don't seem to have any more imagination than radio manufacturers when it comes to the placement of these vital items.

After the above wealth of information has been digested, the awkwardly placed bolt should worry us no longer. In fact, there'll be nuttin' to it!

STICKY PROBLEM

While on the subject of sticky problems, here is another I encountered recently.

It concerned the repair of a not-so-modern loudspeaker, the transformer of which had succumbed to the ravages of electrolosis. I was all for fitting a new transformer, in order that the same fault would not be repeated, but the owner was not keen on the extra expense or the delay which would be involved, and asked me to do what I could to get the thing going immediately.

Apparently he lived some distance out of town and was hoping to get the job done without having to make a second trip. In the circumstances, I decided to give the job priority, as it only involved the fitting of a replacement winding, and told him to call back in half an hour.

I stripped down the old transformer and selected a suitable winding from stock, but imagine my feelings when I tried to fit it and found that the core was an odd size! There was not a great deal of difference, the outside dimensions were normal, and there was plenty of room between the two outside legs.

TOO WIDE

The trouble was the centre leg—it was about 1-8th of an inch wider than usual, which doesn't sound much, but it made it quite impossible to fit. Any attempt to force things would only have ruined the winding.

Yet I had promised the customer and I was very reluctant to break faith in the circumstances.

It seemed that if I could cut a narrow slice off one side of the centre leg there might be a chance, although I didn't relish the prospect of cutting down each lamination individually.

But why not clamp the whole core in the vice and treat it as a solid piece of metal?

It seemed worth a try, so I assembled the laminations in the vice and juggled them into the position I wanted, at the same time being careful to keep all the edges flush.

When I had things to my liking the centre core was horizontal, with the metal to be removed protruding above the jaws of the vice. With everything screwed up as tight as possible I attacked the strip of metal with a hacksaw, using the top of the vice jaws as a cutting guide.

The cut was not a difficult one, as this metal is not particularly hard, but when I reached the end of it I faced another problem. I needed to make a second cut at right angles to the first before I could remove the strips of metal. The saw blade was too wide to go between the centre and outside legs, except at about 45 degrees, so I made a cut at this angle and finished things off with a file.

The winding fitted easily, and from there on it was plain sailing. The re-assembly of the transformer and the fitting to the speaker were completed without any further trouble.

In spite of the initial setback I kept the customer waiting only a few minutes and, as I had kept faith with him, I considered the effort worth while.

Maybe the technique has a definite air of butchery, but, believe me, it saved a headache all round!

AUDIO FREQUENCY DISTORTION

(Continued from Page 49)

at the very low audio frequencies, maximum power output from a tube is not realised because of impedance changes in transformers and reactances. The power output is similarly reduced at the higher frequency because of increased leakage and distributed capacity.

In operation, two frequencies shown on the diagram (Fig. 6) as 100 and 7000 cps, are combined in the mixer. The purpose of the 7000 cps signal is to act as a carrier for the low frequency components.

These two frequencies are commonly used, but a lower frequency ratio must be used if the amplifier under observation has insufficient bandpass. For best sensitivity, the amplitude of the lowest frequency should be 12db above the higher frequency—a voltage ratio of 4 to 1. The output of the mixer is fed to the amplifier under test and its harmonics.

The resultant signal, which is 7000 cps modulated by 100 cps, is amplified and demodulated by the rectifier. It is then fed to a low pass filter to eliminate 7000 cps, and the output is fed to a VTVM, where the intermodulation products are present and the per cent of intermodulation distortion is read directly from the meter.

There is no direct relationship between the percentage total harmonic content and the percentage of intermodulation distortion. With a 12db ratio for the above frequencies, some authorities claim the percent intermodulation distortion is equivalent to:

(h1 h2 h3 .....hn) x (n)

where h1, h2, etc., are the harmonics and is the order of harmonics.

As an example, 10 pc intermodulation distortion is often equivalent to about 2.5 pc total harmonic distortion. Since there are no definite standards for these measurements, any figure of intermodulation distortion must be accompanied by a statement of test conditions.

It is hoped that this brief discussion of audio frequency distortion measurements will be helpful in clarifying the general subject distortion measurements. The next article will be especially helpful to those who wish to construct a simple meter for rapid measurement of the percentage of total harmonic distortion and identification of harmonic wave components.

THE ELECTRON—NEXT TO NOTHING

(Continued from Page 13).

Since electrons are invisible, we cannot directly observe the "picture" they make as the result of striking the object. We make them impinge either unon a photographic plate or on a fluorescent screen when they make a visible picture as in television.

The latest development of this idea is even more remarkable. The electrons as they pass through the object collide with the electrons forming part of the atoms. Every normal atom consists of a neutron with a varying number of electrons around it.

The more electrons the more collisions there will be with the invading stream of electrons and therefore the slower they will be on emerging. Arrange a magnetic field, therefore, so that the electrons are curved around in accordance with their speed as they emerge from the object, and a pattern will indicate with certainty the identity of the atoms in the object — whether they are of carbon, nitrogen or whatever it may be!

This electron microscope analyser is still in its experimental stage, but it has shown that it can, for instance, indicate the chemical constituents of a little dark patch which is only part of a virus so small that it could never be seen with the most powerful microscope!

It is likely to prove a tremendous weapon in the fight against the as yet unconquered diseases.

These are just some of the uses of our new servant the electron. It will season our timber in a quarter the time now required, kill insect pests, or make better ice cream and mayonnaise by giving them a "shaking-up." It will produce better paints.

And in the control of machinery there is no limit to what it will do, except our own ingenuity of setting it to work.

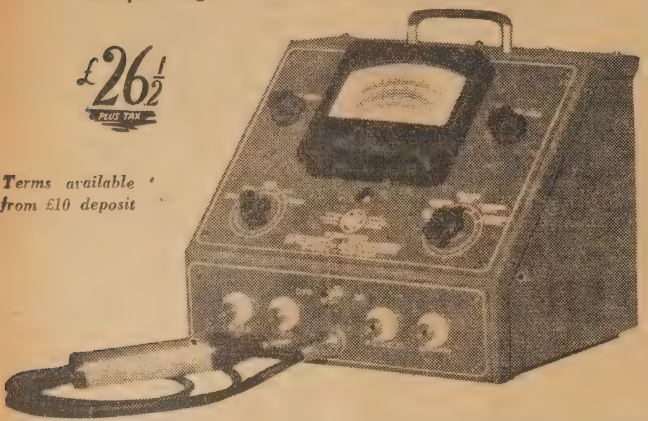
The result of exacting research and design, R.E.L. were rewarded with the ultimate

ELECTRONIC MULTIMETER AND PROBE

incorporating VACUUM TUBE VOLTMETER

£26½ PLUS TAX

Terms available from £10 deposit



This instrument has been developed by R.E.L. to meet the growing demand for an instrument of laboratory sensitivity built in a robust and portable form, for use in conjunction with electronic and other apparatus where it is imperative that the instrument should present a negligible loading factor upon the circuit under test.

- Designed specially for F.M. and Television work.
- Thirty complete ranges (including D.C. x 3 range).
- Independent internal and external diodes for A.C. operation, covering all frequencies from 50 cycles to U.H.F. spectrum.
- The thermionic circuit gives higher meter sensitivity to a specially designed durable moving coil movement (fitted with robust pointer) which it is almost impossible to damage by overload.
- High quality Probe, insulated throughout with Polystyrene.
- Uses one per cent. tol. precision ceramic divider Resistors.
- Clear direct reading two coloured meter scale.
- Contains four valves of the latest type.
- Electronic A.C. circuit, no current drawing metal rectifiers used.
- Electronic Ohmmeter ranges from 0.2 ohms to 1,000 megohms in five steps.
- Input impedance of over 10 megohms.
- Modern slope panel styling.
- Written guarantee with each instrument.
- Low voltage range, 3 volts full scale (1-3 of the scale per volt).
- This instrument incorporates many other unique features and a wide set of ranges so that in operation it is as simple to use as a normal multirange testmeter.

Overall Size 9¾ x 8½ x 8½.
Weight, 15 lbs.

Guarantee

We supply written guarantee with each Electronic Multimeter which covers the instrument for six months.

RANGES

The R.E.L. Instrument
will read A.C., D.C., and —D.C. volts with input impedance over 10 megohms, for all D.C. ranges and only slightly less for A.C. ranges.

High Resistance D.C. Voltmeter
0 to 3v 0 to 10v 0 to 30v
0 to 100v 0 to 600v and 0 to 1800v

A.F., R.F. and U.H.F., A.C. Range
with internal diode or external probe, 0 to 3v, 0 to 10v, 0 to 30v, 0 to 100v, 0 to 600v.

Resistance
five ranges from 0.2 ohms to 1000 megohms.

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PASS THE SALT PLEASE

(Continued from Page 17)

Loud were the protests from the poorer classes and farmers who couldn't afford the tax. The farmers claimed that their pigs were dying off from lack of salt.

The salt plants were shut down by the producers, and smuggling and blackmarkets became rampant just like the present day.

Then the Earl of Dundonald and John Wesley the Methodist campaigned against the tax. Riots broke out and even noblemen joined in the protests until the tax was finally abolished.

Such is the strength and power of this all important commodity. An interesting and humorous finale to this article is a description of how the ancient Chinese sank their salt wells.

After the well site was selected by some magician a wooden frame was erected over the spot. This frame had attached to it some bamboo poles arranged in the form of a lever like a see-saw.

On the end of the poles was an iron rod with a sharp end. This was the drill which was to sink the hole.

At a given signal a dozen or so men would mount the end of the poles thus raising the drill into the air. At another signal they would all step off the poles at the same moment, thus allowing the drill to fall to the ground.

After constant repitition of this process the drill would force its way into the ground. As one narrator has put it, the Chinese could sink a well in this manner to a depth of 3000ft in from four to 40 years.

BAG A SHRINK FIT

A BAG for packaging and preserving perishable foodstuffs that can be shrunk to fit the food closely after being applied, has been patented in US.

This flexible bag is made of about 73% vinylidene chloride and 27% vinyl choride. After the food, such as meat, fresh fruit and vegetables, is put in the bag air is evacuated and the opening sealed with a hot iron or otherwise. Then bag and contents are submerged in water close to but not up to boiling point. The bag shrinks tightly about its contents.

Preserving bags made of this material are claimed to be superior to similar bags of other materials in that they have no tendency to shrink at any temperature encountered in shipping. At temperatures between 85 and 100 degrees Centigrade, however, they will shrink from 30% to 50%. They are clear and transparent. They are capable of being stored for prolonged periods at freezing temperature without becoming brittle.

ANSWERS TO CORRESPONDENTS

L.S. (Matraville, NSW) forwards a circuit of an electronic timer which he feels may be of some interest to those concerned with photography.

A.: Many thanks for your letter and the circuit which we will file for possible publication later. We may be able to publish it on the Reader Built It page or the information may be useful if we are able to conduct some experiments with this, or a similar device, in our own laboratory.

K.A.S. (Lavington, via Albury, NSW) writes to thank us for the present series of articles on photography which he hopes will continue.

A.: Many thanks, and we trust that you will find the future articles just as interesting.

P.C.H. (Elsternwick, Vic) wishes to know whether the Christmas Box mantel would do as good a job as the Little General at his location.

A.: Although the Christmas Box is an excellent little receiver and if properly adjusted should be capable of receiving all the Melbourne stations at excellent strength and separating them cleanly, the Little General has a reserve of gain and selectivity and would bring in a selection of country and interestate stations in addition. The original Three-Band Three receiver employed a 150V 30mA power transformer but you could use a 225V transformer if you wish. Provided the high tension voltage is not over 250, no changes to the circuit will be required but should it happen to work out a little high you could include a dropping resistor between the cathode of the rectifier and the first filter condenser.

J.S. (Brighton, Vic.) writes particularly to tell us of his interest in the present series of articles on photography and also of some of his other activities.

A.: Very many thanks for your letter which was read with interest. We wish you the best of good fortune with regard to your plans for the future and hope that your health has now improved. By the way, we can supply the circuit of a receiver capable of operating from either 240V AC or 6v DC through the shilling query service.

J.R.F. (Mosman, NSW) sends in quite a few bouquets, mentioning in particular The Serviceman, the photographic articles and the efforts of M.W.H. with the drawings.

A.: We are glad you like the magazine and the articles you mention have had a very wide appeal. All the designs are originiated by our own staff and built in our own city laboratory. The relevant drawings and articles are also purely domestic efforts. As a matter of fact, we are one of the few (if not the only) major radio magazines in the world which relies substantially on the efforts of a special staff to produce the technical matter.

H.F. (Brookvale, NSW) writes to tell us of the success which he has had with the Three-Band Three set described in the February, 1951 issue.

A.: Your letter was quite interesting, H.F. We are pleased to note that you were able to follow the description clearly and that with the aid of the diagrams and photographs, you were able to construct the set without any trouble. It was also interesting to read of the results which you have had on both the broadcast and shortwave bands. Glad that you found the bandspread assembly quite straightforward and worthy of its inclusion. We thank you for your remarks concerning the magazine.

P.Y.J. (Ivanhoe, Vic.) wants to know what impedance transformer he should use for a 6in speaker. He also wants to know whether he has need to buy a new transformer whenever he builds a new set.

A.: The impedance ratio of an output transformer depends upon the voice coil impedance of the speaker to be used and the optimum load impedance requirements of the output valve. It is usual for the transformer to be marked with a type number and a figure, ranging from a few thousand to 10,000 to 15,000 or more, which represents the impedance which will be presented to the output valve when the transformer is used with the speaker for which it was designed or with a speaker having a similar voice coil impedance. The voice coil impedance of any speaker can usually be found by noting the speaker type number and consulting the manufacturers' data pamphlet. Most radio supply houses can be of assistance in this respect. It is not necessary to purchase a new transformer for any new set constructed provided that the optimum load impedance requirements of the output valve used in each case is not too far removed from the impedance marked on the transformer. For instance, for all practical purposes, a 5000 ohm transformer could be used where a 7000 ohm impedance was required and vice-versa, without any material difference being noticed. Greater divergences are not recommended, such as using a 5000 ohm transformer where a 15,000 ohm load is required, if something approaching the full output from the power valve is desired.

YOUR QUERY?

1. Queries will be answered in rotation through the columns of our magazine if not accompanied by a fee for a postal reply.
2. Queries, neatly and concisely set out, will be answered by mail as quickly as possible if accompanied by 1/- in postal notes or postage stamps. Endorse envelope "Query."
3. Back numbers are rarely available but reprints of most circuits, wiring diagrams, and parts lists will be supplied for 6d each, minimum charge 1/-. Thus a circuit, layout, and parts list will cost 1/6 in stamps or a postal note. Endorse envelope "Circuit."
4. Blueprints of exact size chassis layouts with all essential holes, and cutouts will be supplied if available for 2/6. Endorse envelope "Blueprint."

Address your letters to the Technical Editor, "Radio & Hobbies," Box 2728C GPO, Sydney.

A.E.B. (St. Peters, Sydney) writes in appreciation of the recent series of photographic articles, and suggests that some articles on enlarging and an enlarger would be of general interest.

A.: Many thanks for the good wishes, A.E.B., and we hope to do something along the lines of your suggestion, there having been a number of a similar nature. It may be some time before this particular subject can be handled and in the meantime we hope you will continue to find the series helpful and interesting.

M.F.F. (Erskineville, NSW) asks our advice about a microphone for the reproduction of music as well as speech. He is considering either a ribbon or a high fidelity crystal type.

A.: Either of the microphones you mention should do an excellent job. The ribbon may have slightly better bass response than the crystal and is better able to withstand the effects of damp weather but requires greater preamplification. The relatively high output of the crystal microphone simplifies the preamplifier problems and since there are no transformers in the microphone circuit the chances of hum pickup are less. Many thanks for the kind remarks and we hope that the above will be of some help.

J.D.L. (Leeton, NSW) writes to thank us for some recent information and to inquire if there are any amplifier circuits due for publication in the near future as this is a phase of activity in which he is most interested.

A.: Thanks for the additional subscription, J.D.L., and no doubt you will have received an official receipt by the time you read this. Although we can give no exact details at the moment, we hope to have something along the lines you suggest in the near future.

C.G. (Balldoran, NSW) sends some suggestions for a series of handbooks and includes a very extensive list of articles which might possibly serve as a basis. He also details some interesting experiments and makes some remarks about valve testers.

A.: Many thanks for your suggestion, C.G., and also for the very comprehensive list which you have prepared. We have something of this nature in mind but time and paper present some problems at the moment. Most grid shift valve testers use some kind of voltage divider network to provide the necessary voltages for the grid shift. In the case of emission testers, particularly, much can be learned from the practice you mention of comparing readings with those of similar valves of known performance especially when the probable life of the valve is the main consideration. Very glad to hear that your Reader Built It contribution had such a pleasant sequel.

C.H. (Yarraville, Vic.) sends us a circuit of a push-pull circuit which he has evolved and asks us to comment.

A.: This idea is not really new, C.H. but has not proved very popular because it does not provide a true push-pull action. If it is assumed that a true push-pull drive does occur, then the decrease in plate current in V2 will exactly balance the increase in V1 which provides V2's drive in the first place. However, if these changes in plate current are exactly equal there will be no change in the current flow through the cathode resistor and V2 will receive no drive. This is, of course, an impossible situation so that what really happens is that V2 creates for itself a degree of drive somewhere between zero and that equal to V1 but never achieves full drive. It is not a true balanced push-pull circuit.

R.E. (Albury, NSW) writes in appreciation of the articles on photography which have been appearing in the magazine since the January, 1951, issue.

A.: Thanks for your letting us know of your interest in these particular articles, R.E. We trust that the subjects discussed in the current and the future articles on this hobby meet with your approval.

G.L. (Canberra, ACT) wished to obtain some information of an ex-disposal receiver.

A.: Sorry, G.L., but we do not file any information on disposals equipment. The best we can suggest is that you write to RAAF Headquarters as we believe that in some cases they are willing to supply copies of instruction manuals &c. Address your inquiry to the Secretary, Air Board, RAAF, Victoria Barracks, Melbourne, Victoria, and mark it for the attention of the Technical Publications Section.

J.D. McD. (No address) comments on a recent article by Professor A. M. Low regarding motive force.

A. It was impossible to reply to you personally because you omitted to include your address on the letter. We cannot reply to your comments at this stage, nor are we in a position to get in touch with Professor Low at short notice since he is an overseas contributor.

B.S.S. (Kilkivan, Q.) asks a question about the meaning of the letters RMS.

A. The letters actually stand for Root mean-square, and express the voltage of an alternating supply in terms such that the heating or lighting power is equivalent to a small D.C. voltage. However, we will follow your suggestion and put the letter aside for attention in our Answer Tom page.

Readers say:

I have a collection of about 300 records and have had some trouble in devising a system of finding any record easily.

The obvious requirements are:

1. A system of storing the records.

2. A reliable index.

3. A system of numbering the records.

The first method of storage tried was a series of albums stored so that the records were vertical. This vertical storage appears the only way to avoid warping of the records. The albums were reluctantly abandoned because:

1. They were too heavy. A dozen 12in records weigh about 9lb, which is a lot of weight to handle to play one record.

2. The bottom edges of the pages quickly wore out, making the album useless. Keeping the bottom edges of the pages away from contact with the shelf imposed too much strain on the binding and the close tolerances needed to make a loose-leaf system were beyond the ability of the firm who cut my materials to shape.

I now use a series of cardboard envelopes, one per record. I had no difficulty in buying several hundred at a moderate cost, and as I received them I found printed spaces for numbers and titles.

The index of records is best left to the taste of the record collector, as each will have problems depending on the nature of his collection.

The covers were numbered with a rubber numbering stamp and the required number was located in the shelf by trial and error. To reduce this, each tenth cover, i.e., number 10, 20, 30, &c., was given an inked edge. Finally to enable a record to be selected at a glance a system of color coding was used based on that used on resistors. Each batch of nine covers, i.e., 1-9, 11-19, 21-29, &c., was given a patch of the proper color, i.e.

1 - 9 Black (Indian ink)
11-19 Brown (vandyke brown)
21-29 Red (carmine)
31-39 Orange (orange)
41-49 Yellow (yellow)
51-59 Green (vegetable green)
61-69 Blue (ultramarine)
71-79 Violet (purple)
81-89 Grey (deep grey)
91-99 White (untouched)

The source of color was found by presenting the nephew with a box of water colors for his birthday and using that. The colors shown in brackets were chosen as being the most distinct.

Carefully applied in a uniform manner to the covers, the colors form a band of color across the shelf which adds considerably to the appearance of the collection.

(A. Newbold).

WE HAVE NOTICED :—

● *That some readers obviously do not study the explanatory article before beginning the construction of a set. As a result, they ask questions which we've already answered. More important, they mount sockets and coils the wrong way round when they have been expressly warned to watch this point.*

● *That there is a tendency to overlook the importance of an external aerial and earth on personal portable sets, when used far out in the country. Small loop aerials are all right round the metropolitan picnic grounds but they are not in the race to pick up a decent signal during daylight in remote areas.*

● *Some readers still imagine that, given a set powerful enough, it is possible to receive metropolitan stations at any time from anywhere in the particular State. A good set may receive the stations on a good night but, in daylight, the signals cannot be expected to travel more than a few hundred miles. Reception over greater distances is more a matter of good fortune than good management.*

● *That many readers are still puzzled by the apparent discrepancies which often occur between our stated figures of valve current and the published data. The most frequent case is with resistance-coupled amplifiers where the plate current may be only a fraction of a milliamp. The same valve under maximum class A amplifier conditions may draw 10 or 15 milliamps. It's all a matter of application.*

● *That several readers have suggested the use of metal rectifiers to allow DC to be applied to heater circuits, thus avoiding difficulties with hum. Actually, a rectifier is only half the story. It would be necessary also to include a rather bulky filter to eliminate the ripple and the consequent likelihood of hum injection.*

● *Too many would-be constructors of personal portables are apparently planning to use two IF stages with the idea of getting greater gain. With standard high-gain miniature IF transformers, there is almost certain to be trouble with instability. The early circuits using two IF stages were designed for the original low-gain English transformers.*

● *Letters regularly turn up requesting us to despatch a radio component or quote our price for it. Radio and Hobbies does not market radio parts—we are purely and simply publishers of a magazine. Consult one or other of our advertisers for quotations.*

ANSWERS TO CORRESPONDENTS

H.J.E. (Nemingha) requires a circuit for a two valve receiver using 1J6 and 1L5 with resistance coupling.

A. We have no circuits in our files which exactly suit your requirements, and we regret that it is quite impossible to design special circuits for individual readers. However, the circuit of Little Jim's Mate, published in March, 1941, may serve as a basis for some experiment as it uses the 1J6 valve. It would be possible to add the 1L5 as a resistance coupled output stage using a .1 megohm resistor as a plate load in place of the headphones and a .5 megohm resistor in the grid circuit of the 1L5. The coupling condenser value is not critical, a .02 mfd. being a usual size. Some bias may be necessary for the 1L5 even when operating on 45 volts and while it might be best to experiment in this regard, a value of 1½ volts would probably be about correct. If the issue referred to is not available we can supply circuit, wiring diagram and parts list at 1/6 through our mail service.

C.P.M. (Berwick) inquires about an American radio magazine which has been printed in Braille. Unfortunately, our correspondent has been unable to obtain full details.

A. We think the book mentioned was probably The Radio Amateurs' Handbook, published by the American Radio League, some editions of which we believe have been published in Braille. We suggest you contact your local booksellers who may be able to import a copy but if this is impracticable it may be better to write direct to the A.R.R.L., West Hartford, Connecticut, USA.

S.H. (Lane Cove, Sydney) requires details of a not-too-dear portable, preferably TRF and using some "GT" valves which are on hand. He also requires that it have sufficient volume to be used in fairly large areas out of doors.

A. As you say, S.H., this is a pretty tall order. In fact to obtain the volume which you apparently require would call for a set far more powerful than can be economically operated from batteries. In any case we have no circuits of the TRF variety designed as portables but suggest that something along the lines of the Pentagrid Four described in June, 1940, might possibly do. This is a superhet circuit but the number of components would not be very much greater than those required for a TRF while the performance will be of a very much higher order. If the issue referred to is not available we can supply circuit, wiring diagram and parts list at 1/6 through our mail service.

A.S. (Sydney) requires some information on various types of model jet engines which were mentioned in Radio and Hobbies for May and July, 1950.

A. We regret that we have no information other than that which was published but suggest that some of the model aircraft supply houses may be able to help you.

H.P.S. (Bendigo, Vic.) has sent a 12 months' subscription and also inquiries as to the possible cause of distortion in his amplifier.

A. Your subscription has been forwarded to the appropriate department together with details of the commencing date. Without having more details of your amplifier circuit it is difficult to say exactly what might be the trouble. Also you do not give details of the source of signal (microphone, tuner, pick-up, &c.) but we assume it is most likely that a pickup is being used. If so, it is probable that the use of two 6SJ7 stages is unnecessary and is, in fact, responsible for the distortion. This would be especially so if the pickup was a crystal or other high output type. Some amplifier circuits using two 6SJ7 stages have been designed for use with modern pickups having a low output and requiring compensation at the base end of the spectrum. This compensation is usually embodied in the first stage. In the event of a high output pickup which does not require compensation being fed into this stage, the voltage supplied to the second stage would almost certainly be excessive, particularly at low frequencies. If you care to supply further details of the circuit and associated equipment we may be able to help you.

ANSWERS TO CORRESPONDENTS

E.W.C., (Heidelberg, Victoria) offers some comment on several articles appearing in a recent issue.

A. Many thanks for your comments E.W.C., which make interesting reading. However there are one or two points which can perhaps stand a little clarification. The article, 20 Years Before Marconi, was not intended to cover all the pioneering work carried out during that period, or for that matter to compare the work of one group with another, but rather to detail the experiences of Thomson and his associates as an interesting example of some of the experiments carried out at that time. Maybe we will be able to cover the work of Hughes and others at a later date.. Your comparison between the two types of crystal is rather an interesting experiment, and raises the point as to whether the crystal itself can effect the selectivity of a circuit. We suggest that the most one can expect of one crystal over another is improved rectifying efficiency and that this would improve selectivity only by allowing it to be tapped across a smaller section of the coil to produce the same volume. By reducing the loading on the coil the efficiency of the tuned circuit would be improved, thus permitting better separation of signals. Your suggestion for the erection of poles is an interesting variation on normal procedure, and in many cases would reduce the number of helpers needed. However it pre-supposes that the so-called jury mast is already firmly set in its own base support, and perhaps suitably guyed. As normally used the jury mast does not require this elaboration, being merely a means of applying the required lifting force at the correct angle.

D.P. (Brisbane, Q) writes in appreciation of many of the articles appearing in Radio and Hobbies, and expresses his intention of taking up radio again after a lapse of many years. His immediate interest is the Minivox and he is puzzled by the inclusion of a 50,000 ohm resistor in the parts list which does not appear in the circuit. He also wants to know if a larger transformer can be used with a dropping resistor, so that this item will be available for a larger set.

A. The 50,000 ohm resistor appears in the circuit as .05 megohm, and will be seen wired to one end of the .25 megohm reaction control pot. There is no objection to the use of a larger transformer in conjunction with a suitable dropping resistor, it only being necessary to see that the voltages applied to the valves are within normal ratings. However, the dropping resistor may have to dissipate considerable power, and it is as well to make sure that it is capable of handling this power as well as providing adequate ventilation to prevent nearby components being affected by heat. Glad you find the magazine so interesting D.P. and we hope you will continue to enjoy it.

R.J.M. (Elmshurst, Vic.) is interested in the Electric Organ Uses Neon Tubes article which appeared in the April issue of Radio and Hobbies, and would like to obtain a copy of the original article.

A. Sorry we are unable to supply a copy of the original publication R.J.M. but it was Electronics for January, 1951. It is unlikely that any of the bookstalls will be able to help you but the Sydney Public Library can usually supply photostat copies of technical articles at a very reasonable charge.

J.G. (Brisbane, Q) is having some trouble with the 1949 Babygram, having substituted a 6J8 for the 6F7. Main trouble seems to be inability to obtain good performance at both ends of the band.

A. The 6J8 cannot be regarded as an exact substitute for the 6F7, particularly in a set of this kind where the two sections are used in different parts of the circuit, it is probable that the change has made the reaction control unduly critical, which may account for the variation of performance over the dial. You do not give any indication of the manner in which the reaction is performing, but it must be realised that the success of these small sets depends on the satisfactory performance of this control. It should provide smooth control of regeneration over the whole of the band, although the setting will vary a little with frequency. Alignment should be carried out on the high frequency end of the dial by means of the trimmers across each section of the gang.

W.J.B. (Launceston, Tas.) is anxious to obtain a recipe for making ink for ball point pens and is hoping that some of our readers may be able to help him.

A. We are printing this in the hope that someone may have the information you require and if so they may care to write direct to Mr. W. J. Bayes, 187 Invermay Rd., Launceston, Tasmania.

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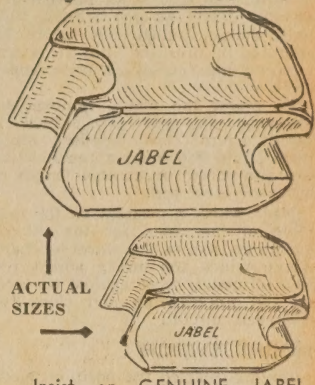

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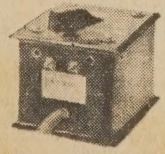

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P.O. Box 9 (H), Gerringong, N.S.W.

SIMPLE RADIO TIME SWITCH

WARTIME microswitches, which have been available from some disposals dealers, greatly simplify the task of rigging up a time operated switch. The microswitch should ideally be one with a very light action, which can easily be operated by pressure from the alarm winding mechanism of an ordinary clock.

To adapt the clock, remove the ordinary ring-type grip which is fitted to most alarm winders, run a thread into the hole in the existing cap and screw in a short length of brass or steel rod.

Next, select a position on the rear plate of the clock for the microswitch so that, as the alarm mechanism unwinds the newly added rod will ultimately bear against the arm on the microswitch and close the electrical circuit.

MOUNT SWITCH

Having selected the position, mark the cover carefully, and remove it so that two small mounting holes can be drilled. Then wind the alarm to a sufficient pressure and reassemble the clock.

To set the clock, wind the alarm spring an additional half turn so that it will be clear of the microswitch trip arm. When the alarm operates, the protruding rod on the winder bears against the trip arm and closes the circuit. This can be made to operate the radio directly or any number of devices through a relay system.

Considerable care should be taken with the leads and insulation, particularly if the wires are to carry 240 volts directly.

One satisfactory method is to make up an assembly using a power plug and socket, with a plywood spacing block between them to lend rigidity and to prevent accidental contact with the internal connections.

CONNECTIONS

The earth and one line connection is established directly between the plug and socket but the other line connection is brought out by a length of flex and terminates at the microswitch on the clock. This puts the switch in series with one supply lead.

An adaptor along these lines avoids the necessity for any interference with either the power point or the radio. The adaptor is simply plugged into the power point and the radio plugs into the adaptor. Setting the clock breaks the circuit to the radio and it does not come on again until the alarm operates in the morning.

It has been estimated that some two billion cubic feet of timber in the US is lost each year by fire, insects and disease. But one year's growth of new wood amounts to approximately 11.2 billion cubic feet.

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FOR SALE: Quantity of R & H books, also condensers, coils, valves, etc. Wonderful value. Apply to **B. H. Whitby, "Rosemont," Rocky Hall, via Bombala, N.S.W.**

FOR SALE. Decca FFR Hi-Fi Pickup with spare saphire. £8 or offer. **D. McEvoy, 112 Norton St., Leichhardt, or ring MA1661 9-5.**

FOR SALE. Cigarette Lighters, storm type, brass and black metal with two spare flints. English make, 4/9 ea. Money refunded if not satisfied. **Rowe, Box 742, G.P.O., Sydney.**

FOR SALE. University model D.11 V.O.M. Meter. New. Best offer. **R. Jolly, 1 Moodie St., Carnegie, Victoria.**

FOR SALE. 1 Dial CD1/ with .0004 single gang condenser. Price £1/4/6. 1 Dial USL32 with .0004 3 gang condenser. Price, £2/17/3. Please write **Douglas Whitby, Rocky Hall, via Bonabala, N.S.W.**

FOR SALE. New model 512 "Zenith" Modulated Oscillator. Perfect condition, £16/10/-. **K. Woodford, 29 Murray St., Rockhampton, Qld.**

FOR SALE. Decca FFR Player. Spare sapphire. 10 watt amplifier P.P. 2A3's. 2 mike inputs and P.U. all separate channels. Crossover network with Rola 12-0 and 6K speakers. £50 or offer. **P. Bessell, 132 Doncaster Ave., Kensington. M6391 9 to 5.**

SELL. FS6 Transceiver and power supply New and unused. **9, The Crescent, Homebush. UM7243.**

SELL. No. 11 Transceiver, complete as new. Also D104 Crystal Mike 6 valve PR6L6 Amplifier complete with 12" VL Amplion speaker. Best offer. **L. Garfield, 33 Payten Ave., Punchbowl, N.S.W.**

SELL. Special offer 90 loose and bound copies of R.H. from 1939 to present. £1. **D. Dennis, Coolangatta, Qld.**

SELL.. Bendix TA 12D Transmitter Modulator-Power Supply Unit. C condition with full kit of tubes as Offers wanted. **Box 49, Merredin, W.**

SELL. Communications R1155A valves, 5 bands, 18 mcs to 75 kc's S meter and PU terminals, etc. Per condition. AC power pack £40, or offer. **A. Lloyd-Jones, YMCA, Melbou**

SELL. Palec MO1 Oscillator with in output meter. Reasonable o **W. Sleaford, William St., Rosewood.**

SELL. Eddystone 640 Receiver, new dition, with speaker and instruc book, £55. **M. Long, 6 Moonya Rd., Iris, WM1565.**

SELL.. University Signal Tracer, £10. 1 power tranny. 550/550 250 6.3 at 8, 5 at 3, £5. 1 Astatic D104 chrome adj. stand approx. 8yds lead. **A. Rutter, 21 Shaft St., Lithgow.. Ph.**

SELL. Brand new 12" C.R.T., 5" C Elect.. Deflection, multi voltage C Transformer and Filter Choke. accetylene jets and cutting head. Slig used double con. Super 13 tube 12" spe er, single sig. reception. 12 Watt mo lator, 50 watt mod.. transformer. offers? Particulars from **R. C. Steph Trentham, Vic.**

WANTED. Recordings. "Liza" Wh man's Swinging Strings (Decca) Y "Song of the Islands," Wayne King's O (HMV) EA735; "Stars and Stripes," Sou Band EA87; Also any records by Fla gan and Allen on Columbia. **Frank Puls, Burke Rd., Lower Ferntree Gu Victoria.**

EXCHANGE. 1 Philips C.R.O. 2" for 35mm Enlarger. Must be in g order. Also, Class "C" Wavemeter Crystal Calibrator ZAA519 for good ph graphic gear. **T E Straughair, 64 F cis St, Yarraville, Victoria**

EXCHANGE. 13 Tube, 2 Metre Recei less Speaker for Class "C" Waveme **N. Lawrence, 19 Bennett St., Nth. R mond, Victoria.**

KNOW YOUR DEVELOPE

(Continued from Page 79)

our own drawing office from information contained in the Ilford and Kodak books already mentioned. Line "A" is for Kodak Microdol as it should be used for Super XX 35 mm film in a tank. Line "B" is also for Microdol, but modified to suit Super XX roll film.

Line "C" is for Ilford MQ developer at dish concentration, and as shown is adjusted for Selochrome roll film. The information was taken from a portion of the table not shown in the reproduction.

It should be noted that these two developers are quite different in type, hence the difference in development times and slope, and later indicating a different response to temperature variation.

A further factor effecting the development times is the method of development, that is whether by tank or dish. The whole subject of tank development is one we hope to cover in detail at a later date, but for the moment a brief explanation may be in order.

Tanks normally require consid ably more solution than do dis and in the interests of economy i usual to dilute the developer, creasing the development time compensate for the weaker soluti Thus tank developing times are n mally longer than dish times.

The amount of agitation also eff development times, and when int mittent agitation is specified (as the case of Microdol), the tank velopment time will be still furt increased.

These points may help to expl why there exists such large diff ences in developing times, vary from a minute and a half in so cases to 15 or 20 minutes in oth

The principles outlined in t article should enable you to m the widest possible use of any veloper. There should be no need rule out a particular type on score that the information suppl does not suit you. As a result, y choice of available products sho be widened considerably.